PAVING AND MUNICIPAL ENGINEERING

A Journal Devoted Specially to Street and Sidewalk Paving, Sewerage, Water-Works Construction, Street Lighting, and all Matters Pertaining to Municipal Engineering.

Published on the 15th of Each Month.

WILLIAM FORTUNE, Editor. - - - WILLIAM C. BOBBS, Business Manager

OFFICE: ROOM 44, CHAMBER OF COMMERCE, - - - INDIANAPOLIS, IND.

Entered at the Post-office, Indianapolis, Ind., as second-class matter.

SUBSCRIPTION: { One Year, ... $1 00. / Single Copy, ... 10.

FOREIGN SUBSCRIPTIONS.

Great Britain and Australia...6 s. sterling.	Austria.....4 florins.
France.....8 francs.	Germany.....6 marks.

Advertisements to insure publication should reach the publication office not later than the 5th of the month.

Communications are invited, and all requests for special information on the subjects treated by this journal will receive careful attention.

Articles relating to the different branches of municipal engineering are desired. Stamps should accompany manuscripts for return postage if unavailable.

Vol. III. INDIANAPOLIS, IND., OCTOBER, 1892. No. 6.

CONTENTS.

	PAGE.
The Nomenclature of Asphalt and Bituminous Products.....*Leon Malo, W. H. Delano.*	119
Asphalt Paving Experiments.....*V. W. Foster.*	121
Size of Paving Brick.....	121
Production of Hydraulic Cement in the United States.....	122
Electric Traction for Street Railways.....	123
For Good Common Roads.....	125
Specifications for Paving Brick.....	125
Width of Wheel Tires.....	126
Street Cleaning and Sprinkling in Different Cities.....	126
Cost of Street Cleaning in New York.....	127
Information About Clay-Working Machinery.....	127
Water-works of Madison, Wis.....	128
Important Considerations in Street Paving.....*W. L. Dickinson.*	128
Rapid Work in Laying Paving Brick.....	129
Personal.....	129
Recent Legal Decisions.....	129
New Patents.....	129
Road Machinery Exhibit in Georgia.....*W. A. Huff.*	129
IMPROVEMENT AND CONTRACTING NEWS—	
Paving.....	130
Sewerage.....	131
Water-works.....	132
Bridges.....	132
Street Lighting.....	132

The columns of this publication are open to the discussion of all subjects relating to paving, sewerage, water-works, street-lighting, and the physical improvement of cities. Practical information as to the merits of materials used in such work and new methods, with photographs and drawings, which may be used for illustration, are especially desired. We are glad to get brief notes as to proposed improvements and the letting of large contracts.

City engineers are requested to send us as early as possible copies of their annual reports, which will be given proper notice.

Articles relating to methods of road making and maintenance are invited.

THE NOMENCLATURE OF ASPHALT AND BITUMINOUS PRODUCTS.

By Leon Malo, Consulting Engineer, Pyrimont, Seyssel, France.—Translated by W. H. Delano, Paris.

SEVERAL technical journals in the United States have in these latter times raised a discussion concerning the denominations that it is convenient to attribute to the various bituminous products used at the present time for roadways and sidewalks of towns. My adversaries have often done me the honor to cite my name either to approve or criticise the system of classification proposed by me twenty-five years ago and since adopted in all European countries. It will no doubt be permitted to me as the author or the culprit of this system, perhaps also as the engineer who has studied this question the longest, to bring my contingent to this interesting discussion. I shall try to be clear and brief.

When, about the year 1857, I began to occupy myself with the asphalt business, then just beginning, the greatest disorder reigned in its phraseology. The words bitumen, asphalt, tar, pitch were applied at hazard to all bituminous products. The treatises on chemistry (which, by the way, all or nearly all, gave erroneous notions concerning the industrial use of this product), were the ones more obscure than the others on this subject—indeed, one may say that there was an utter confusion of language. After several years of study, during which I had the opportunity to collaborate in the creation of the apparatus and methods now in use for the application of bituminous products to public works, I found that it was necessary to be clear as regards nomenclature. In so doing, I trod on the toes of no scientist and took away no one's prerogatives, for, at that time, no one was occupied with the study of these materials which since have become so important; no special writer had addressed himself to the practical and industrial side of the question. Thus, in proposing a nomenclature which has been criticised twenty years later by several well known American engineers, I was opening up an untrodden path and believe yet that at the present hour this nomenclature, notwithstanding that I am its author, is the most clear and reasonable that can be adopted.

The principal ingredient in the application of the products in question to street work is the matter known as mineral pitch or bitumen. Bitumen (an oxygenated hydro-carbon), a substance well known and when pure, similar to itself, is remarkably fit to be used as the unity in the classification in hand. It will take different names according to its combination with other materials and by its combination it will acquire new properties but it will always be the starting point and the invariable characteristic of the identity of bituminous products. It was resting upon this principle that I proposed the nomenclature which now excites such tardy criticisms, the general features of which may be resumed as follows:

Original Matter.	Products in which bitumen figures as the element of industrial use.
Bitumen or Mineral Pitch.	When bitumen impregnates limestone naturally, the product is asphalte. When bitumen agglunitates quartzous or quartzo-calcareous sand, the product is butuminous sand. When it is mixed with clay, the product is Trinidad lakepitch (or, commercially speaking, crude Trinidad.—Translator's Note.) When mixed with bituminous linestone (*i. e.*, asphalt), melted and run into blocks such as are used for sidewalks, the product is called bituminous mastic. (Of which Seyssel wrote in the type.—Translator's Note.)

This system of classification has the advantage of rendering perfectly clear the part played by mineral pitch or bitumen in its divers manipulations and to show that under whatever form it presents itself, whatever may be the material with which it is found combined, it itself is everywhere the useful element and gives to its combinations their industrial value.

The classification is therefore simple and logical, and, as said before, has been adopted in all European countries where bitumen products have been used for street work.

In 1888, in a paper read at a meeting in Buffalo, an American

engineer attacked for the first time, I believe, this system, which, up to that moment, had met unmolestedly with public favor. What particularly seemed to sadden the mind of Captain Greene was my alliteration of the word "asphalt" to the mineral calcareous limestone when he had appropriated this name to especially designate the impure bitumen mineral with clay which forms the pitch lake of the island of Trinidad.* I must express my regret for having, in 1866, taken possession of a name of which Captain Greene had need for his private ends twenty years later. But I can not help it now; the word has passed into everyday language.

In his pamphlet of 1888, Captain Greene, after having convinced me of being ignorant of Greek, obligingly teaches me that the expression asphaltos (asphaltes), derived from that language, became asphaltum in Latin, and then claims the authority of Homer, of Milton and of the Bible to demonstrate that the expression could only be applied to the products of Trinidad Lake.

My lexiological erudition is not of sufficient strength to wrestle with that of Capt. Greene, whose thesis has been questioned and combatted by several American engineers quite recently. Therefore, I have not taken up my pen to refute that, but only to establish the fact that my nomenclature is to-day in use over all Europe where asphalt work is carried on, and that, supposing it to be not at one with the Greek grammar, which I do not admit, it would cause a regrettable perturbation in special technical language to modify its terms now.

It may be permitted to me to take up here in the pamphlet of Capt. Greene, an insinuation which affects me personally, an insinuation repeated after him by other polemical writers in America. Capt. Greene accuses me of having confiscated the word "asphalte" in favor of the company to which I belong and lets it be understood that, under these circumstances, I had subordinated the interests of science to those of private interests.

If, instead of belonging for thirty-five years to a company which owns the mines of which I direct the technical service, I were a book-worm, savant, or a theoretical engineer, it is probable that I should never have improved the asphalt trade nor written upon that material the books which have provoked this discussion. In any case, when I attributed to the mineral bituminous limestone the denomination "asphalte," it seems to me I did nobody any harm.

At that time, I remember, the earthy pitch from Trinidad, in France, at least, was only used in the following way: A portion was distilled to extract the oil; this oil mixed with another portion of raw Trinidad pitch, served to soften it to get rid of a certain quantity of its clay and so render it, by this partial refining, fit to be used as bitumen for the manufacture and laying of asphalt mastic. Later on this oil was replaced by shale grease (*goudron de schiste*). During this period nobody ever dreamed of claiming for Trinidad pitch the name of "asphalt." It is only now that the system of roadway known as compressed asphalt has become so much extended in Europe that it has appeared of interest to some to create a confusion between these two products and make the one profit by the rising fame of the other.

The actual question is not, therefore, to know whether Greek or Latin authorize or not the application of the word "asphalt" to such or such a product—what is important is to establish quite clean cut distinction between bituminous products which, with their various merits and titles, are used in asphalt street work—in one word, we have to avoid that these materials be mistaken the one for the other.

It is useless that the material extracted from the Trinidad Lake should in consequence of an erroneous denomination be confounded with the ore extracted from asphalt mines, seeing that their nature, their geological form, their industrial properties are different.

Whether the ore be industrially superior or inferior is not the question before us. Neither Capt. Greene nor I can decide that. Experience alone is the sovereign judge in such matters. All we can do and ought to do, is to try and prevent one material from being mistaken for the other. Let each material have its own status and each bear the merit or the responsibility of its employment.

If we were at the origin of this industry and the classification were not made, I should not dispute with Capt. Greene and his associates the property of a name which would then belong to nobody. I would have taken another name for asphalte which no doubt would not have hindered it from making its way into the world. But it is after a quarter of a century now that roadways in compressed asphalt have taken an extraordinary extension all over Europe. Now that use and custom have conferred upon the material employed for this system of roadway the name of asphalt it is that the promotors of Trinidad Lake pitch emit the pretension to seize upon a name which does not belong to them at the risk of letting it be believed that they want to apply to themselves the profit of other people's renown.

It appears to me quite superfluous to bring forward so much philology concerning a question which was resolved thirty years ago.

We call in Europe, and shall continue to call, asphalt, limestone naturally impregnated with bitumen which has the property, after being ground to powder and heated, of being compressed by ramming it down on a solid base and then to make a roadway relatively elastic and noiseless. We call, and shall continue to call, Trinidad, pitch, the material gotten from the island of that name, and which, prepared and applied according to certain methods, enters into an important part in the street work of many big cities of the United States.

The confusion which it is tried to create between these two products is all the more inopportune since they are on the point of meeting and measuring themselves with one another on the great American continent to the great profit, I hope, of the beautifying and salubrifying of its towns.

In this proximate eventuality it is convenient, on the contrary, that no confusion should exist between the two, and that each should be clearly designated so that the merits of each remain personal and distinct. Moreover, the question of competition between the two products has less importance upon the soil of young America, where there are immense outlets for both, than upon that of aged Europe, where space for rivalry is less vast. In these new towns of the United States, already on the morrow of their birth gigantic, the first necessity is that of a track both rigid and salubrious. Nowhere is the roadway elastic, anti-porous, and insonorous, more desirable, and for both systems there is a vast career. The victory will be long to the system which is the most durable and the least costly for maintenance; to the one which will best withstand the constantly increasing wheel-wear of big cities—that in Paris, for instance, has reached unparalleled, almost incredible, proportions.

Etymological discussions are therefore useless. The struggle is between two materials, each of which has to show what it is worth. On the one hand, Trinidad pitch, employed in many big towns of America; on the other hand, asphalte, as used in the chief capitals of Europe.

Their names and their origins matter little, provided they give sound and durable results; it is not a dispute about words, however learned and prolonged it may be, which will render them more or less excellent. Experience is the only judge. That one should borrow from the other a name it has borne without contention for twenty-five years may cause momentarily some trouble in the minds of those who use them, but sooner or later the mask must be thrown off and each will take the part due to it.

Why not begin by doing so at once?

LEON MALO.

NOTES:—The translator, a twenty-years' disciple of Mr. Malo, takes the opportunity of deprecating the use in engineers' and architects' specifications of such words and phrases as "asphaltum" and "asphaltic cement," both of which substances are de-

*We call bitumen, the Latin for pitch, to be now an English synonym of pitch, and more used adjectively; thus, bitumen concrete, bituminous cloth, instead of pitchy concrete, pitchy cloth, no longer sufficiently precise terms.—TRANSLATOR'S NOTE.

rived not even from the Trinidad pitch lake, but simply from petrolium.

In the building and road-making trades it is convenient to use the word "cement" only in its simple, every-day meaning of the gray powder usually composed of 21 parts clay, 79 parts lime amalgamated in water, dried, baked and ground fine, known as hydraulic or Portland cement, or the natural or Roman cement like the Rosendale, both of which, mixed with pebbles, sand and water, make concrete for walls and foundations. Again, a concrete made of pebbles, sand and gas-tar should not be called a "bituminous concrete," as if it were made with Trinidad or other similar mineral pitch, but "gas-tar concrete."

Borrowed plumes should not be worn and let every tub stand on its own bottom, so as to prevent confusion and error, willful or unintended.

ASPHALT PAVING EXPERIMENTS.

By V. W. Foster, President Western Paving and Supply Company.

ASPHALT paving in this country began about seventeen years ago. Samples of that kind of work had been laid some years previous in European cities. Trinidad Asphalt had been discovered and experiments had been made in the matter of mixing and using it. Companies were formed in eastern cities who undertook to construct such pavements commercially. As very little was known of the nature and practical working of this material, many different formulas were tried and in some cases clays were mixed with the asphalt, and carbonate of lime and sand in different proportions. It was only after many failures that formulas were obtained that produced satisfactory results.

In reviewing their mistakes, pavers with asphalt of the various kinds found that they were sometimes caused by the propositions of their ingredients. In other cases it was found that some of the various "asphalts" lacked the properties necessary to make a bond with the other material. At the end of a long chapter of such experiments it has been determined by experience that the Trinidad Lake Asphalt is a safe material, if properly manipulated, with which to build pavements and that it is safe to give responsible guarantees on them.

The labors of those laying Standard Trinidad Asphalt pavements have been very much in their history like the exprience of scientific men engaged in other lines of business, and the methods of to-day are as much in advance of those employed in their first work as are the methods now employed in the manufacture and manipulation of iron and steel in advance of the methods of twenty years ago. This lesson has been fully learned by the expeperienced asphalt pavers, viz., that the best results are obtained only by infinite care and attention to details. No paver can succeed even approximately in our business who, after taking the contract, undertakes to economize either in the quality or quantity of the material used, or in the labor and pains taken in construction.

I believe that the successful and experienced asphalt pavers of this country and Europe are as faithful and conscientious in the construction of their work as are professional men or any class of merchants.

To insure the best results in any pavement as much attention should be given to the question of maintenance as to the details of construction. There is no doubt that much better satisfaction would have been given by any of the forms of pavement if this condition had been observed. While many asphalt pavements have remained in good condition more than five years without repairs, still I would not expect that however faithful our construction might be, that our work might not need some small repairs within such a period of time. I think that the maintenance contract with responsible parties, adds very largely to the value of the pavement to the property owner. I would not be willing to engage, as has been suggested by a cedar block paver, to construct an asphalt pavement anywhere and bind myself not to repair it if it should appear to be necessary. Such a practice would not be in accordance with our method of doing business, and I fear that if repairs appeared to be necessary that we should do them even at the expense of being put in prison by the cedar block gentlemen, as he suggested.

SIZE OF PAVING BRICK.

HARDLY any two manufacturies make paving brick of the same size, says M. D. Burke in his recent pamphlet on "Brick for Street Pavements." One of the first steps to be taken by manufacturers, he thinks, should be the adoption of a standard size for street paving bricks. "Obviously their preference would be to make blocks of about the same dimensions as building brick for both uses. When they make paving blocks only, and sell by the square yard, their interest will lie in the direction of increased thickness and diminished width. A large majority of manufacturers supply material for brick masonry as well as for paving, and can assort their output without material loss, thus enabling them to supply better goods for paving when they are required so to do, without suffering the entine loss of the value of such as may be rejected. This, from the manufacturers' stand-point, is the greatest argument in favor of making the dimensions of paving the same as building brick.

"The users' side of the question should be considered. The width of the brick or block forms the thickness or depth of the pavement. This should not be less than four inches. If made much in excess of that depth its cost will be increased about in the ratio of the increased depth. Inasmuch as four inches will afford ample strength and weight to resist the wear of the traffic to which this description of pavement is suited, there appears to be no reason for materially increasing the width beyond that named unless it be to meet exceptional cases. In the future, should it appear that brick are so perfected as to be able to carry the extremely heavy traffic concentrated upon business thoroughfares, where granite block pavements are now thought to be most suitable, a greater width may be found desirable. The length of the brick or block should be about twice its width; its thickness should not exceed its width and may be made equal to it, providing such a block can be properly burned. The writer does not say that manufacturers can not properly dry and burn a brick three or four inches in thickness, but he does say that they do not do it. The conditions and the experience of all indicate failure when massive pieces are sought to be burned into bricks or block suitable for street paving. The nearest approach to success has been attained by making the blocks hollow on the lower side in order to facilitate burning. For the solid brick a thickness of two inches, or at most, two and one-half inches, is as great as should be attempted. Even where the clays can be melted or "vitrified" readily, there is great risk incurred in attempting to increase the thickness, for such clays usually contract greatly, and the outer surface is almost certain to be fixed or seared by the intense heat before the inner portions shall have been so acted upon as to produce the required vitrification. As a consequence, they come from the kiln either insufficiently burned, checked with "fire-cracks," either internal or external; like an ill-shaped casting, so affected by internal strains as to have no certain amount of strength. Better results are, therefore, likely to be secured by adopting about the building brick dimensions than by attempting to manufacture blocks of a larger size. Unfortunately those dimensions have never been determined with much accuracy in this country, but they should be, and then let manufacturers vary the dimensions of their molds as the contractially of the clays vary, so that brick of equal hardness shall be of like dimensions.

"It may be argued that the increased number of joints in a given area, caused by the thinner block, constitute an element of weakness, and should, therefore, be avoided. The defect is more imaginary than real, since the proposition can not be true if made general. The perfect pavement would become one without joints, which is impracticable unless made of a substance sufficiently yielding or elastic to afford secure footing for animals, which practically makes it a surface of innumerable joints. An advantage claimed for brick pavements is said to be the fact that they can be so closely laid, and the joints so completely filled, that, while they furnish secure footing for animals, they are so smooth as to be

quiet, and so impervious as to be cleanly. If this be true, the additional number of joints is not objectionable. They are not an element of weakness, since the load must in any case be carried by the foundation, and the upper and lower surfaces being equal, the weight transmitted by the brick will be as its area. Should the surface of the foundation be uneven, the smaller block is less liable to be tilted by an unequal pressure than the larger one. Within reasonable limits, therefore, the safe course to pursue would undoubtedly lie in the direction of the thinner blocks; or, in other words, to adopt a standard size for paving blocks corresponding with building brick dimensions."

PRODUCTION OF HYDRAULIC CEMENT IN THE UNITED STATES.

THE latest report of the United States geological survey, just published under the direction of Major Powell, gives the following statistics as to the production of natural road cements in the leading districts during the years named:

Localities.	1889. Barrels.	1890. Barrels.	1891. Barrels.
Rosendale, New York	2,547,250	2,683,579	2,815,010
Louisville, Ky.	1,338,464	1,533,579	1,501,200
Buffalo and Akron, New York	682,275	698,396	745,450
Lehigh Valley, Pennsylvania	350,000	450,000	520,000
Milwaukee, Wisconsin	350,600	400,000	425,000
Utica and Lasalle, Illinois	350,000	400,000	450,000
Potomac River	200,000	200,000	250,000
Fort Scott, Kansas	150,000	150,000	140,000
Mankato, Minnesota	78,912	87,650	101,875
Onondaga and Schoharie Counties, N. Y.	225,000	202,000	215,000
Virginia, Georgia, Texas, Ohio, Missouri and New Mexico	270,000	277,000	288,000
Totals	6,531,876	7,082,204	7,451,535

The above statement was compiled at the close of the year 1891 by Mr. U. Cummings, who has collected statistics of this character for many years. In preparing a statement of the technical features involved in cement manufacture for the report to follow the volume just issued, Prof. Spencer B. Newbury made an independent canvass of the entire country, and the following table shows the results of this work:

	Works.	1890. Barrels.	1890. Value.	1891. Barrels.	1891. Value.
Georgia	1	40,000	$40,000	40,000	$40,000
Illinois, Utica and LaSalle	2	363,117	292,784	409,877	276,931
Indiana and Ky. (Louisville region)	11	1,533,579	1,150,184	1,513,009	983,456
Kan. and Mo. (Kan. City and Ft. Scott).	2	175,000	122,500	135,000	94,000
Md., Hag'rst'n, Cumberl'd & Hancock	3	223,209	203,785	204,900	187,855
Minnesota, Mankato	1	87,650	65,787	101,875	76,406
New York, Onondaga Co.	8	281,086	183,268	288,941	188,944
New York, Ulster Co.	17	2,683,579	2,213,982	2,815,010	2,252,008
New York, Schoharie Co.	1	25,357	20,286	27,055	21,644
New York, Buffalo and Akron	4	765,734	560,277	788,300	575,283
Ohio, Bellaire and New Lisbon	2	57,000	56,000	70,000	68,000
Pennsylvania (Lehigh Valley)	6	555,000	243,900	695,000	536,600
Tennessee, Chattanooga	1	48,428	43,540	33,100	36,026
Utah, Salt Lake City	1	.....	.....	5,000	10,000
Virginia and West Virginia	2	20,000	15,000	20,000	15,000
Wisconsin, Milwaukee	1	450,000	180,000	460,000	150,000
Total	63	7,308,734	5,582,243	7,607,067	5,512,153

PRODUCT OF PORTLAND CEMENT IN THE UNITED STATES IN 1890 AND 1891. BY SPENCER B. NEWBURY.

	Works.	1890. Barrels.	1890. Value.	1891. Barrels.	1891. Value.
California, San Diego	1	.....	.....	5,000	$15,000
Colorado, Denver	1	12,500	$40,000	12,500	40,000
Dakota, Yankton	1	.....	.....	31,818	71,579
Indiana, South Bend	1	15,000	36,000	15,000	36,000
New York, Onondaga Co., Buffalo, etc.	5	65,000	140,000	87,000	290,000
Ohio, Bellefontaine and Columbus	2	22,000	49,000	35,000	82 000
Pa., Lehigh and Lawrence counties	7	221,000	439,050	268,500	582,850
Total	18	335,500	704,050	454,818	1.067,429

The average price, considering all grades of natural rock cement, was 72 cents per barrel in 1889, 70 cents per barrel in 1890 and 68 cents per barrel in 1891. This is for cement in wood. The lower prices are due, to a considerable extent, to fierce competition in the West. Fully one-half of the cement sold at Buffalo, New York, and all points west of that, is in sacks. All cement sold in Buffalo and west of it is rated at 265 pounds to the barrel; all sold east of Buffalo contains 300 pounds to the barrel, and Portland cement is 380, so that there are three different weights for a barrel of cement in this country. The fact that Portland cement is frequently said to do better than the natural cement may be in many cases due to the fact that one-third more cement is given to the barrel.

Cement imported and entered for consumption in the United States, 1868 to 1890.

Years (a).	Quantity. Barrels.	Value.	Years (a).	Quantity. Barrels.	Value.
1868	.....	$10,168	1880	.....	$373,264
1869	.....	19,855	1881	.....	441,512
1870	.....	18,057	1882	370,406	683,684
1871	.....	52,108	1883	456,418	802,294
1872	.....	172,339	1884	(b) 585,768	825,095
1873	.....	209,097	1885	554,396	874,070
1874	.....	286,429	1886	915,255	962,689
1875	.....	262,741	1887	1,514,095	1,470,846
1876	.....	247,200	1888	1,835,504	1,731,456
1877	.....	201,074	1889	1,740,356	1,704,253
1878	.....	184,086	1890	1,940,186	2,249,741
1879	.....	$212.719	.....	.....	.....

(a) Calendar years ending December 31 from 1886; previous years end June 30.

(b) Classed simply as cement, kind not specified since 1883. It is probable, however, that about 95 per cent. of the total imports is Portland cement.

Lime and cement of domestic production exported from the United States—1864 to 1890.

Years (a).	Quantity. Barrels.	Value.	Years (a).	Quantity. Barrels.	Value.
1864	.....	$86,386	1879	60,657	$74,097
1865	.....	94,606	1880	41,989	52,584
1870	31,175	61,490	1881	57,555	83 598
1871	27.575	51,585	1882	67,030	100,169
1872	39,686	69,218	1883	74,687	120,156
1873	27,873	52,848	1884	65,768	108,437
1874	41,349	69,080	1885	79,627	127,523
1875	64,087	98,630	1886	83,247	123,687
1876	53,827	77,568	1887	63,520	97,771
1877	78,341	97,923	1888	100,070	147,309
1878	82,507	98,334	1889	89,995	142,298
.....	.....	.....	1890	86,963	152,295

(a) Calendar years ending December 31 from 1886 to 1890; previous years end June 30.

A new and important discovery of cement rock was made during 1890 in the coast range of mountains near Sierra Peak, about three and one-half miles southwest of South Riverside, in Southern California. It is owned and controlled by Messrs. Fraser Brothers, of South Riverside, California. It comprises about 330 acres in extent, and is fully ninety feet in thickness.

It lies in horizontal strata, the edges being exposed in a canon passing through it. It is capped in most places by three to five feet of limestone. The deposit lies partly in Orange and partly in San Bernardino counties, the county line running north and south through its eastern portion.

A thorough examination of this deposit was made during the spring and summer of 1891 by a competent authority on cements, and it developed qualities as good as any known cement deposit; only trifling variation exists in the portion of ingredients between the upper and lower layers, and a thorough admixture of the different layers, calcined and ground together, resulted in a cement showing the following analysis:

Silica	24.34 per cent.
Alumina	8.56 "
Lime	63.62 "
Magnesia	.40 "
Oxide of Iron	2.08 "
Alkalies	1.00 "
Total	100.00 "

The rock is blue-black in color, and it is extremely fine grained, hard and compact, the fracture conchoidal.

A series of tests of the cement extending over a period of eight months exhibit no signs of shrinking, swelling, checking or disintegration. It bears submersion immediately after being made up

into balls, patties or briquettes, and it neither heats nor falls down, and its duration is in perfect keeping with the laws governing the action of first quality hydraulic cements. Several experiments were made as to its Portland-making qualities, and it was found that a first quality of Portland cement can be produced without the admixture of any extraneous material whatever, as shown by the analysis.

The Portland experiments were made by grinding the various layers together in the raw state, then moistening sufficiently to press into balls or cakes, and exposing to a white heat until the point of incipient vitrifaction was reached, the clinker, after a gradual cooling, was reduced to powder and spread out in a thin layer for a week, and then made into briquettes and tested in the usual way—by tensile strength per square inch. The following table is the average result of many tests:

Hours in air.	Days in water.	Breaking strength per sq. in.—lbs.
1	1	135
1	7	280
1	30	475

The table following is the result of several hundred tests of the cement made after the manner of natural cements, by first calcining the rock, then reducing it to powder. All stages of calcination were resorted to from an under-burn up to the melting point, with a view to the development of imperfections, if any existed:

Hours in Air.	Days in Water.	Average breaking strength per square inch. Pounds.	Hours in Air.	Days in Water.	Average breaking strength per square inch. Pounds.
1	1	115	1	28	291
1	7	178	1	90	354
1	14	223	1	210	485
1	21	256			

A bed of good bituminous coal about seven feet thick probably underlies the entire cement rock deposits, as it is mined on both sides of the mountain range adjacent to the cement deposits, and it is probable that the coal can be reached at a reasonable depth by sinking a shaft in the canon mentioned, and the shaft would undoubtedly pass through a bed of snowy gypsum of at least 40 feet in thickness, judging from the exposures on both sides of the narrow mountain.

No cement is produced in California, the entire supply coming from Europe, amounting in the aggregate to upwards of a million barrels during the year 1891.

"Two or three attempts have been made to produce artificial Portland cement in that state," says Prof. Newberry, "but the excessive cost has tended to a discontinuance of that industry. Therefore the discovery of this vast body of cement rock, containing upwards of 300,000,000 barrels of the raw material, from which a cement of most excellent quality can be produced at a very low cost, must prove of incalculable value to the people of that state, as it is located in the very heart of the famous orange belt, where the demand for cement for the construction of irrigation dams, canals, and pipe lines, is already immense, yet increasing, and must continue to increase for many years to come. A first-class cement plant capable of producing 1,200 barrels per day, is projected and will probably be put in operation during the season of 1892 on the line of the Santa Fe railroad system at South Riverside, California, the rock to be brought down to the plant by a narrow-gauge system."

ELECTRIC TRACTION FOR STREET RAILWAYS.

IN a paper read before the recent annual meeting of the American Street Railway Association, on the subject of electric traction, Mr. McIntire said:

"Electric systems as first constructed were built on altogether too light a plan, and the increasing tendency year by year has been, and is, for heavier and more solid construction in every department, but particularly in the way of track and station equipment. The storage battery has made but little progress during the past year, and is not likely to cut much of a figure in electric traction until it is able to make a better showing financially than it has in the past.

"*Track.*—The improvement in track construction has been very great. During the past year heavier rails have been rolled and better joint plates made, so that it is possible to keep the roadbed in perfect line and surface. This improvement has been a great help to the electric equipment and has reduced the cost of maintenance. As the cost of laying tracks is about the same, whether light or heavy, it is economy to put in only the best.

"Now, on the question of what constitutes the best form of track, there is considerable variance of opinion. My experience and observation has convinced me that the deep girder rail, about nine inches high, spiked directly to the ties, is the best form for paved streets, and in dirt or macadam streets, a six-inch girder rail laid in the same manner. In the country and where the local authorities are willing, I would lay a T rail, spiked directly to the ties. The weakest place in all forms of track construction is at the joint. Every manufacturer of rails, and many of the railroad companies, have tried to overcome this trouble. Up to the present time there has been nothing brought out which surpasses a properly designed 'fish plate.'

"While speaking of track construction, it might be well to call attention to the bonding of rails for the return circuit. Many forms have been used, and some of them are still in operation. I believe that a No. 0 copper bond wire long enough to connect with the web of the rail on each end of the fish plate is the best plan, and then grounding the whole system at frequent intervals, and abandon the supplementary wire which it has been the custom to use with the common form of bonding.

"*Motors.*—Probably the greatest advance in any particular line has been in the matter of armatures for motors and dynamos. I consider that the introduction of the 'iron clad' type will do more toward reducing the bill for repairs in that direction than any other one thing that has been introduced during the year. The electric companies have all, I believe, now adopted this form as their standard, and all roads that have tried them will, I think, agree with me that, for simplicity, ease of repair and ability to stand the hard usage they receive, they stand at the head.

"Many roads, acting under a misapprehension of the requirements, started off with motors too small for the work, and endless trouble has been the result. Some new classifications should be adopted by the electrical companies for designating the power of their motors, as the present 'office classification' does not afford a proper understanding of its capacity, and the 'horse-power' term is but little better, depending on so many limiting conditions. A more satisfactory way would be to specify the number of pounds the motor can pull at different speeds, with the maximum current for which it is designed.

"*Trucks.*—The first car trucks employed in electrical work were of the pedestal form; that is, the trucks were fastened to the car body and oscillated with the car. The motors, of course, had to be suspended from the car body, and the result was that the grinding of the gears was transmitted through the whole car; also, the oscillation of the car body caused the motors to correspondingly rise and fall. This was very undesirable, and it was soon found necessary to adopt the post form, in which the truck was complete in itself and the motors supported directly on the frame of the truck. The body was connected with the truck only by springs, thus being entirely free from the jolts and pounding of the trucks.

"In this form slight spiral springs were first used, the same as in the previous styles, but it was soon found that the high speed attained caused the body to oscillate to such a degree that it became very objectionable, and the different builders then modified their trucks by extending the side bars beyond the axle boxes a sufficient distance to allow an auxiliary spring to be added at each end. For this auxiliary support, coil and elliptical springs have been used, both forms with marked success, and it is now possible to carry a car body twenty-eight feet over all, practically without oscillation. This last modification has been a very great improvement, and has settled the long car question on most street railways. I mean by

this that but very few double truck cars will be used, though, of course, there are places where two trucks can be used to advantage, and in such places they will still be employed. But where we are able to carry nearly as many people on four wheels as on eight, and to apply the power equally on each axle, so that there is no possibility of lack of traction, there can be no gain to the railroad company in using eight wheels.

"*Power Stations.*—This may be rightly called the heart of any electric system. The chief element to be considered should be reliability, and, after that, economy. Just what means shall be used to attain this end seems so far to have been a disputed matter, as shown by the stations now in operation, which contain almost every conceivable device, good, bad, and indifferent, all shapes, sizes and descriptions of engines, boilers and dynamos. The recent introduction of large multipolar dynamos has brought about a change in station arrangements not heretofore obtainable, and in all large stations now being built countershafting is dispensed with entirely, and the general tendency is toward reduction of parts, which in turn means simplicity. It is very probable that we have reached now a form of station that will be fairly permanent, and the main point in the future will be the size of the units. For medium size stations engines with releasing valve gear belted direct to multipolar dynamo will be the best where the price of land is not excessive, and direct coupled engines and dynamos for larger stations. To my knowledge there have been no comparative tests made as to the economy of the various types of stations, although all reasoning would point to these latest types as being by far the most economical.

"There has been heretofore too much taken for granted or assumed in electrical work, and the rapid growth of the business has called into it many who were totally unqualified for the positions which they obtained. I attribute much of the unsatisfactory work in the past to this course, but am happy to note that the great majority of these are passing into the background, and their places are being filled with men of good judgment and mechanical resources."

In the discussion that followed, Mr. McNamara said: "Mr. McIntire failed to tell us if anybody has tried the deep girder rail, which he refers to, and found it any better than the system which he recommended to us a year ago. We are using the ordinary tram rail; and I still hope that we are right and he is wrong. As to the large generators, it is very comforting to know that you have got a machine that is capable of delivering a large amount of power, but if it breaks down, what then? Your large unit is taken out of service, and, unless you have a correspondingly large unit to take its place, you are left without power. It is a question for us whether it is desirable to increase the size of the units, and, if so, what should be the limit. Of course, I take it that the limit is only reached when you are enabled to duplicate the unit; because no one would attempt to operate a railroad, electric or otherwise, unless he were able to operate it continuously; so that if one of your large units fails, you must have another to take its place."

Mr. Beckley: "In other words, the expression is relative. What would be a large unit for the Rochester Railway Co. would be a small unit for the Brooklyn City Railroad Co."

Mr. McNamara: "Yes, that is it. We have found that in Albany we have worked very successfully with small generators. We have had more than ordinary success, as it seems to me, in operating small generators. Our success has been so great that it was not until a week ago that we lost our first armature—running nine or ten machines. We discovered a defect in the armature which compelled us to take it out. Lightning has been in the station numerous times, but we have escaped its destructive influences and it has been safely carried to the ground."

Mr. McIntire: "The form of girder rail I refer to is laid on fifteen miles of road in the northern part of New York. It weighs seventy pounds per yard and is laid on yellow pine stringers five by five. The rails are spiked directly to the stringer, which rest upon cross ties. I use a joint-plate 26 in. long, bolted with six bolts. I put a tie directly under the rail joint, and one under where the timber joints; the balance of the ties are spaced 36 in. on centers.

Mr. Lewis: "Do you advocate an absolutely rigid joint?"

Mr. McIntire: "Yes, in paving. There is nothing else that you can put there that will stand. It will go down if the joint is open and the wheels are allowed to pound. The rail men will immediately inquire, What will you do if expansion takes place? If you lay a center bearing or tram rail in this manner, you get into trouble because it is exposed to the sun and expansion will take place; but with a deep girder rail down in the earth you do not have that trouble."

Mr. Lewis: "Do you put your rails close together?"

Mr. McIntire: "Yes, solid together."

Mr. Beckley: "Did you pass through last summer with this road?"

Mr. McIntire: "Yes, sir."

Mr. Cleminshaw: "Is that the road you built in New York?"

Mr. McIntire: "Yes, sir."

Mr. Cleminshaw: "Then you have not given it a test with an electric system, except during the last week?"

Mr. McIntire: "That is all."

Mr. Cleminshaw: "That settles the question."

Mr. McIntire: "The trucking on Third avenue is equal to any wear on the track which will be given it by electric motors."

Mr. Cleminshaw: "There is nothing known in traction that compares with the pound on the track which is given by an electric motor."

Mr. McNamara: "I have seen some of this seventy-pound rail that was laid last year on a road operated by horses, and it has got a pound at every joint that you can hear."

Mr. McIntire: "It was not constructed properly. If you will lay your track and put your rails solid together, and bring the joint plates home with the bolts and properly tap it as it is drawn up, and see that it is supported properly, you will have a good track. If you lay stringers you have got to put on knees, and this increases expenses and the deep girder rail is almost as cheap to lay as the other forms. As to dynamos, I have not seen any that begin to compare with the new type of iron-clad armature, multipolar dynamo, and I can not see why we should have any trouble with them. Of course, if something happens to the engine you must have a relay."

Mr. Powers: "To my mind the first question that presented itself in this matter of electric roads and tracks was the problem of the joints. The steam roads have solved this question to their satisfaction, perhaps not altogether, but practically so, so that you can not count the joints as you ride over the best tracks. The general idea of the railroad man is to make his rail continuous, and then the question of supporting the joint becomes one of secondary consideration. The ordinary joint for street railroad tracks and electric railroad tracks has been merely something for keeping the ends of the rails from spreading apart vertically. After all the experience the steam railroad people have gone through, and the enormous weight they get on a single pair of driving wheels, the fact that they have solved the problem to their satisfaction should be of value to us; while most of the so-called joints in the street railroad business have been formerly tried on steam roads and are not satisfactory. It is no uncommon thing to find a new piece of electric track going to pieces in a short time. One reason is the sparseness with which the ties are apt to be put in. We put them in less than 2 feet apart centers; less than 16 inches at the joints. We stagger the rail joints."

Mr. Cleminshaw: "Any one who runs an electric road six months knows that there is nothing so important as this matter of joints. The steam roads can screw up the nuts at the joints. We can not do that in a street railroad, as they are underground. There is not an electric road in existence to-day that has run one year that has got a perfect joint. We built a road about 15 months ago, 63-lb. rail, new pavement, new ties 30 in. apart, and everything first-class. It ran six months very well, but to-day it is

going. There is no remedy. We have come the nearest to it with a suspended joint."

Mr. George W. McNulty, engineer of the Broadway railroad, New York, was to have prepared a report on "Recent Improvements in Cable Traction," but owing to the fact that it had not been possible to get the road in operation before the time of the meeting, as was expected, he requested that the report be deferred until the next meeting. The request was granted.

FOR GOOD COMMON ROADS.

AN invitation has been issued to Good Roads Societies to be represented at a congress to be held in Chicago during the World's Fair dedicatory season. It is believed that the opening of the Columbian Exposition this month offers a favorable opportunity for the inauguration of a movement of this character. For this reason all farmers' associations and other organizations interested in the subject of good roads, with all active private friends of the movement, are invited to be present. The intention is to hold a meeting for the preliminary organization of a national league for road improvement. In speaking of the matter the Chicago *Tribune* says:

"This action is in the line of progress. In several of the states there are societies devoted to road improvement, and a union of all those interested should hasten the day when the different parts of the country will be joined by good, permanent highways, instead of the avenues that now alternate between sloughs of mud and almost Sahara-like dust. The league may be expected to arrange for a congress to be held next year during the Fair, in other ways to bring the matter before the people and to press on Congress the necessity for a National Highway Commission, a bill for which passed the senate at its last session but did not reach the house.

"In many parts of the country the problem is a difficult one. Gravel is scarce and material for macadam is none too plentiful in Illinois, while limestone, when used for that purpose, has the unpleasant habit of rising in the shape of dust. But this makes it all the more important to secure good drainage, underdrains of ordinary farmers' tile being used either under the middle of the road or on both sides of it. Preferably the latter. Then it will be comparatively easy to keep the road free from the pans and gullies in which water rests after a rain and rots away the material subject to its action. Without that good roads can not be maintained, however much be expended on them at first, and the fact is pretty well understood by the farmers of this state, who have led all the rest in the improvement of their lands by tile drainage.

"Then the cutting up of the roads by thin wheels must no longer be allowed. Four inches is the narrowest width of tire that ought to be permitted to a two-horse wagon.

"The farmers do not need to wait for the advent of better roads before adopting the broad tire. It gives so much advantage on poor roads as well as in the preservation of good ones that it is a wonder its introduction has been so long deferred. It can hardly be doubted that many farmers would now have their old wagons fitted with broad tires and still more by only the broad tires in making new purchases, if it were not for the intense conservatism of wagonmakers in the cities and repairers in the country. These people should be labored with, asked to attend the congress, and induced at least to offer their patrons a choice between the new and the old. It should, however, seem to be not difficult to induce the manufacturers to see that it would be to their own benefit to make broad tired vehicles on a liberal scale and offer special inducements to purchasers who will introduce them into localities where the broad tire is at present an unknown quantity."

SPECIFICATIONS FOR BRICK PAVING.

A paving company of Columbus, O., says on the subject of brick street paving in that city: "Much depends on street paving being properly done. Specifications vary in different cities but we believe, after noticing the work done in all parts of the country, that the street work in Columbus is on the whole superior to that in any other city. This indicates that we have a good specification, and one that can be copied to advantage elsewhere. Condensed, it is practically as follows: Grade to required depth. Make a foundation of broken stone eight inches deep and roll with a ten ton steam roller. If soft spots appear in the foundation, remove the soft earth underneath and fill with broken stone. On this foundation lay the blocks or brick on edge in a bed of sand two inches deep. Ram the blocks or brick thoroughly, using a wooden flatter and rammer so that no iron shall come in contact with the paving material. Sweep enough fine sand in the joints to fill between the block or brick one inch from the bottom. Fill the remaining three inches with hot coal tar pitch at the heat of about 350 degrees. In applying the pitch it can be poured on the surface of the pavement and worked into the joints with a broom. Cover the surface with a light coating of sand. The paving blocks must be hard burned and free from cracks or breaks, and must be laid so as to break joints.

"Many small cities and towns are about to pave one or more streets. To such we offer some suggestions. The temptation will be strong to use a cheap material. If you yield to that temptation you will make a serious mistake. You will do well to investigate carefully before risking failure in order to secure cheapness. If you secure well made blocks, and have them properly laid, you will have a serviceable pavement for twenty years, while you are liable to get a pavement which will not last five years if a cheap brick is used.

"As street assessments are usually made by the foot front of property on streets improved, the following table is prepared. From it can be ascertained at a glance the probable cost of street improvements at a number of prices. The figures are based on a paved roadway thirty feet wide, with five-inch curb on each side and circle curb at intersections of streets. Ordinary catch basins for surface water are also included in the estimate, and ten per cent. added to entire cost to cover the cost of paving the street intersections.

Pavement costing	$1.50	per sq. yd.,	$3.25	per ft. front.
"	1.60	"	3.43	"
"	1.70	"	3.51	"
"	1.80	"	3.80	"
"	1.90	"	4.00	"
"	2.00	"	4.17	"
"	2.10	"	4.35	"
"	2.20	"	4.53	"
"	2.30	"	4.71	"
"	2.40	"	4.90	"
"	2.50	"	5.07	"
"	2.60	"	5.25	"

"An addition of 25 cents per square yard to cost of paving material will only add 45 cents per foot front to the cost of improvement, while it is likely to add 200 per cent. to the durability of the pavement.

"Concrete foundations have been adopted in many places in preference to broken stone as used in Columbus. Many engineers believe that they make enough better work to warrant the extra cost. We admit that a good concrete foundation, laid under favorable conditions, is the best that can be made, but the conditions are very often unfavorable. For instance: Nearly all street work obstructs travel, to the disadvantage and loss of business conducted on the street. A plan of work that results in completion in the quickest time, and still makes good work, is best because it reduces the loss to a minimum. A broken stone foundation can be laid in almost any kind of weather and can be paved on at once. On the contrary, concrete can not safely be laid in wet weather or while the subgrade is soft and muddy from rain. The concrete when laid must set at least one week before fit to lay pavement on, thus adding a week to all other delays. The temptation is strong under such conditions to lay the concrete on improper ground and to pave on concrete that is too fresh. Either error is fatal to a good and permanent foundation, and will account for much of the defective pavement to be found when concrete foundations are used. If ground is soft in spots where broken stone is

laid, and settling occurs in the rolling, more stone is laid on and rolled until solid, or the soft dirt is removed and space filled with broken stone. The ten ton roller discloses the defect and it is cured. The concrete laid on a soft bottom is not tested by a roller, and the weak places do not show till after the pavement is laid, when it is too late to repair the damage without great expense.

"The Columbus pavements are all (except asphalt) laid on an eight-inch broken stone foundation, and our observation is that they are, as a whole, more uniformly free from depressions arising from poor foundations than in any other city.

"We give it therefore, as our opinion, that when broken stone can be obtained at a reasonable price, the saving in cost, together with the time gained in improving streets, will warrant its use in preference to concrete."

WIDTH OF WHEEL TIRES.

MR. JAMES H. WINDRIM, Director of Public Works in Philadelphia, has submitted to the authorities of that city some information relative to the width of wheel tires in saving street pavements from unnecessary wear. He says that the omnibuses running on Broad street, in Philadelphia, have an average tire of only two and one-half inches. During the repaving of Broad street, at an expense of $204,643 in 1892, this omnibus traffic was diverted to side streets with lighter pavements. The result was that in fourteen days damage to the amount of $6,000 was done in displacing paving, broken crossing stones, sewer man-holes and stop-boxes for gas and water. This all happened in an area of 16,635 square yards of street pavement.

As a result of Mr. Windrim's direction of attention to the subject a broad-tire ordinance is now before select and common councils of Philadelphia. The ordinance is intended to regulate the width of tires running over asphalt pavements, and provides that: For a wagon with its load weighing 4,000 pounds, the tire shall be three inches wide; 5,000 pounds, four inches wide; 6,000 pounds, five inches wide, and 7,000 pounds, six inches wide. It also provides for a fine of twenty-five dollars on each vehicle violating the ordinance.

One of the recent consular reports from France says on this subject:

"The American pavements are very much better constructed than are those of France, all classes being considered. They, however, become destroyed in a short time, while those of France increase in excellence with age, until the difference is very marked. These differences arise from neglect with our authorities to properly repair, and from the constant damage inflicted by the narrow tires of freighting vehicles."

"Every freighting and market cart here (Havre, France), is a road-maker. Its tire is from three to ten inches in width, usually from four to six, and so rolls the road.

"With the few four-wheeled freight vehicles used, the tires are rarely less than six inches, and the rear axle is about fourteen inches longer than the fore, so that the rear, or hind wheels, run in a line about an inch outside of the line rolled by the fore-wheels; thus with a six-inch tire two feet of road width is well rolled by every passing wagon.

"The varied gauge is also usually observed with cabs, hacks, and other four-wheeled vehicles, so that they become road-makers instead of rut-makers, as in our country."

In discussing the same subject the *Engineering News*, in a recent number, says:

"We pay altogether too little attention to the subject of tire-width, both in our cities and in the country, and it is time that we were putting into practice regulations that have long existed in other countries. We have failed to find any specific American city ordinances on this head, and the late road law of the State of Michigan, simply providing that users of wide tires are entitled to a rebate of half their road-tax, is a rare exception in state legislation of this character.

"English road laws provide that where the load per wheel is from one-half to three-quarters of a ton, the width of tire shall not be less than three inches; where the load ranges from three-quarters to one ton, minimum width shall be four inches, and from one ton to one and one-half ton per wheel, the tire must be at least six inches wide. Vehicles with springs may reduce this tire width one inch. This law practically coincides with German and French regulations on this subject.

"The effect of narrow tires, with a heavy load, upon modern street paving, has not yet been carefully studied and reported upon. But it needs no special study to convince an observer that present practice imposes a heavier duty upon such pavement than is necessary, in the face of possible municipal legislation. In the case of stone blocks a broad tire may distribute the imposed load over the base of two blocks instead of one, and in the case of an asphalt pavement, ruts are much less likely to occur than with the narrow wheel.

"But as the change of wheels would be a costly operation in the aggregate, the salient question is, How can this be done with the least damage to individuals? There is no doubt that a compulsory law could be framed and, if need be, enforced. But the better plan would probably be to directly tax the user of narrow tires under heavy loads, and to free from all tax the men who conform to established regulations. Such an arrangement would give time for the change and yet contain an inducement for as rapid a change as possible. This is practically the same principle that now induces the owners of certain newly built country roads to remit tolls on such vehicles as conform to published tire requirements. Broad tires are certainly better for use on soft or yielding roads; and on paved or well built macadam roads the tractive force is independent of the width of tire, provided this width exceeds three or four inches. To the objection that English wheels are clumsy and we will not have them, it can be answered that if broad tires are made the law, wagon builders will soon eliminate the clumsy features. It seems a bit unwise to adopt modern street paving methods and yet to refuse to use every reasonable precaution for the better preservation of these costly pavements."

STREET CLEANING AND SPRINKLING IN DIFFERENT CITIES.

MAYOR WASHBURNE, in a recent message to the city council of Chicago, gave some valuable information on the subject of assessments for municipal improvements and of methods of street cleaning and sprinkling in different cities, the facts having been largely gathered specially under his direction. A condensed statement of the information set forth in the message is given below:

In Chicago, special assessments against abutting property are levied for sewers, house drains, sidewalks, lamp posts, street and alley paving, water mains and water service pipes. For some reason, not plainly indicated in the report, the assessments, which are levied before the work begins, are in excess of the cost of the work necessitating rebates after the work is completed and often depriving property owners of the use of considerable sums of money for several months. In addition to this defect in the method, it has been possible for property owners to secure from the city council a "stay order," which may either delay or entirely stop improvements under way. The city pays its contractors in warrants instead of in cash, and as the warrants can be realized on only at a discount, the work of the city is not done on a cash basis.

At Minneapolis the assessments are also based on estimates, but the estimates are so close that rebates are seldom necessary. The assessments are payable in five annual installments, bear 6 per cent. interest, and go into a "Permanent Improvement Revolving Fund, against which are issued 4½ per cent. thirty-year bonds, which are marketable at par.

Regarding street cleaning, Mayor Washburne states that of the six cities, New York, Chicago, Philadelphia, St. Louis, Minneapolis and Indianapolis, the latter is the only one which pays for street cleaning by special assessment. The work is done by contract, the

cost in 1891 having been 44 cents per 10,000 square feet each cleaning, for wood and brick, and 34 cents for asphalt pavements. Frequency of cleaning varied from weekly to daily. The cost to property owners for the whole season, June 1 to Dec. 31, 1891, varied from 2 1-6 to 10 cents per front foot, depending upon material and width cleaned. Macadam streets in both Indianapolis and St. Louis are cleaned only once a year.

At St. Louis the streets are cleaned under three-year contracts. Most of the sweeping is done by machines, between 10 P. M. and 7 A. M. All piles of sweepings must be removed from the streets within two hours. The sweepings are hauled about four miles to barges and finally dumped into the river. The present contracts for street cleaning in St. Louis are as follows: Granite and wood pavements, 48 cents, and asphalt, 38 cents, each cleaning, per 10,000 square feet. The entire cost of street cleaning in St. Louis, including administration and care of barges, was about 60 cents each cleaning, per 10,000 square feet, or $11.40 per mile of 36-foot roadway, material not stated.

In Philadelphia, in 1891, the average cost per mile for street cleaning, removing ashes, garbage and dead animals, was $11.47 per mile, the work having been done by contract.

In Chicago, in 1891, the cost of cleaning 7,160 miles of streets (frequency not stated) and "doing an unknown amount of scavenger work and removing dead animals," was $544,386, or an average of $27.50 per mile. This is high as compared with the figures for other cities compiled by a special New York commission, which in 1891 reported that the streets were cleaned in New York for $20.09 per mile; in Philadelphia for $11.47; St. Louis, $9.12; Indianapolis, $8.36; Buffalo (asphalt), $7. Of course it will be understood that in these figures no account is taken of the width of street and perhaps several other dissimilarities.

Chicago is absolutely without street sprinkling, at least so far as city service goes. At St. Louis, Indianapolis and Minneapolis the streets are sprinkled by special assessment.

At St. Louis about 450 miles of streets are said to be sprinkled four times a day for six days and three times on Sunday, the service extending from March 15 to Dec. 1. The work is done by contract, there being a separate contract for each of the 45 districts. In 1891 the average cost of sprinkling per front foot of abutting property was 3½ cents. There are 20 inspectors, in addition to the whole police force, to see that the work is properly done. For each omission of sprinkling a proportionate deduction is made from the contractor's monthly payment. In one year these deductions amounted to $48,000, but the next year, as might be expected, the amount of deductions was small. In this connection it may be stated that the contractors for street cleaning once attempted a combination. All bids were rejected by the street commissioner as too high. The commissioner at once had introduced in the city council an ordinance empowering him to supply any street cleaning contractor with the necessary plant, the cost to be deducted from the monthly payments. New bids were asked and the combination was broken, the tenders being much lower than those received at the first letting.

About 70,000 special assessment bills for sprinkling are required annually in St. Louis. These bills were made out last year in two month's time by a temporary force of clerks in the tax commissioner's office at a cost of only $1,948. The assessments are collected with the other city taxes. The estimated amount of water used for sprinkling in St. Louis in 1891 was 4,000,000 gallons daily. Water is furnished by the city without charge. The contractors are paid directly from the city treasury each month.

At Indianapolis 70 miles of streets are sprinkled three times a day from April 1 to Nov. 1. The work is done by contract and its average cost in 1891 was 7½ cts. per front foot of abutting property.

At Minneapolis contracts for street sprinkling are let by wards by the aldermen of the respective wards. City officials make out and collect the assessments and pay the contractors. The cost per front foot on unpaved streets ranged in 1891 from 2 to 7½ cts., averaging 5⅛ cts. for the season. On paved streets the average cost was 6½ cents and the range from 4 to 7 cts.

It is stated that in St. Louis the cost of engineering and inspection is less than two per cent., while in Chicago it ranges from 5 to 15 per cent.

COST OF STREET CLEANING IN NEW YORK.

ESTIMATES for cleaning the streets of New York and removing ashes and garbage during 1893 place the total cost at $2,569,253. The total appropriations for this purpose thus far in 1892 have been $2,093,355, about $188,000 having been granted since the annual appropriation was made. The estimates for 1893 are distributed as follows:

Administration, office force of 24, and supervisory force of 146, $193,970; sweeping, 1,575 sweepers, 150 machine and water cart drivers, all at $600 per year, and sundries, $1,085,000; carting, 675 drivers at $600.92, hostlers at $720, shoeing and feeding 950 horses at $182.50, and sundries, $671,815; removal of snow and ice, $40,000; final disposition by means of tugs and scows, $322,800; new stock, as horses, carts, harness, etc., $197,338; rentals and contingencies, $58,330. The salary list varies from $6,000 for the commissioner of street cleaning to $600 for sweepers.

The city is now divided into eleven districts, each under the charge of a superintendent. There are fifty eight street cleaning districts, each under the charge of a foreman. The superintendents and foremen are each responsible for the cleanly condition of the districts under their charge, and the sweepers are also held responsible for the length of street which it is their duty to sweep.

During the first eight months of 1892 there have been removed a total of 1,260,221 loads of dirt, against 1,135,045 during the same period of 1891, an increase of 125,176 loads, or about 11 per cent.

The new street cleaning law provided for 1,500 sweepers, 750 drivers and 88 hostlers on the start, with an addition to the force of 5 per cent. per year. The commissioner, Mr. T. S. Brennan, reports that the system is efficient but that while the advisory committee which formulated the new law thought the above force would be large enough at the start to clean the whole city, it has been found that at least twice the number of sweepers are required to clean all the paved streets and avenues, allowing one sweeper to each 600 or 800 feet of streets, according to width. The down town streets are principally cleaned by hand and the upper part of the city by machines, operated at night.

INFORMATION ABOUT CLAY-WORKING MACHINERY.

J. W. PENFIELD & SON, of Willoughby, Ohio, have just issued a new catalogue of seventy-two pages on clay-preparing machinery, giving about all information on that subject that could be desired. By way of introduction they say: "For reducing some kinds of clay, disintegrators are best adapted; for others, roller crushers; while still others require a wet pan or dry pan to produce uniform and satisfactory results. Under some circumstances, the use of a taper tub pug mill for the further manipulation and the tempering of the clay is productive of the best results. Under other circumstances a granulator, open top or upright pug mill may have some points of advantage, and should therefore be selected. The fact that we wish to present forcibly is, that the machinery to be used should in all cases be selected after careful consideration of the nature of the material to be prepared, and of the conditions under which it is to be worked."

They also make an important suggestion, which is general in its application to those making inquiries about clay-working machinery, as follows:

"The capacity of clay-preparing machinery depends lagely upon the kind of clay used and its condition as it comes to the machine. In even the same clay, under different conditions, the capacity of any machine may vary widely, and hence estimates for capacity are based on what might be called an average condition and quality of clay. It will aid us materially if you will fully describe to us the nature of your clay as it comes from the bank, whether it is lumpy, hard or soft, and the kind and size of stones, if any, in it; in fact, a complete description of the clay as it comes to the machine, and the results you wish to accomplish. We will then know

what style and size of machinery to recommend for your use, thereby avoiding the liability of making mistakes in the selection of an outfit. When considering the purchase of clay preparing machinery, always figure to secure a surplus of strength and capacity. The extra investment required to do this will be a profitable one."

WATER WORKS OF MADISON, WIS.

A VERY complete report of the water-works of Madison, Wis., prepared by J. B. Heim, superintendent, has just been issued in a pamphlet of fifty-one pages, with maps and illustrations. The following is a summary of the essential information in the report covering the points outlined by the American Water-Works Association for such report:

Population by census of 1885, 12,063—by 1890, 13,246; kind of engines, two non-condensing Reynolds-Corliss, with Knowles pumps combined; capacity, 1,500,000 and 2,500,000 per diem; system, direct pressure; source of water, eight artesian wells; number of days pumped, 365; average pumping time per day, 24 hours; total number of gallons pumped during the year, 197,889,450; number of gallons pumped per month, 16,907,787; number of gallons pumped per day, 542,162; total number of water takers, 1,405; daily average amount pumped for each water taker, 314 gallons; greatest amount pumped during the year, per day, gallons, 925,000; smallest amount pumped during the year, per day, gallons, 375,000; difference in consumption during year, 550,000; number of gallons pumped for one cent of fuel, 924 3 5; averaged head pumped, in feet, 214; dynamic head on pump by gauge pressure, in pounds, 92½; total revolutions of small engine during the year, 14,440,800; piston travel in feet, per minute, 163 feet, 10 inches; total revolutions of large engine during the year, 853,500; piston travel in feet per minute, 11½; number of gallons pumped per one pound of coal, 189½; total amount of coal consumed during the year, in pounds, 1,044,000; total amount of coal consumed, in tons, during the year, 522; total amount of coal consumed per month, pounds, 87,000; total amount of coal consumed per day, pounds, 2,860; total amount of coal consumed per hour, pounds, 119; total amount of coal consumed per square foot of grate surface, pounds, 4 19-25; net combustibles during the year, in pounds, 887,160; net combustibles per month, in pounds, 73,846; net combustibles per day, in pounds, 2,430; net combustibles per hour, in pounds, 110¼; net combustibles per square foot of grate surface, pounds, 4 7-16; average non-combustibles per day, in pounds, 454; per cent. of non-combustibles, 16; kind of coal, Anthracite, pea; price of coal per ton, $4.31 and $4.10—average, $4.20½; cost of coal during the year, $2,140.20; cost of coal to raise 1,000,000 gallons one foot high, 5 1-20 cts.; duty pounds of water raised one foot high with one hundred pounds of net combustibles, 38,716,600.

The total receipts during the year were $15,372.26, and the operating expenses amounted to $7,564.25.

IMPORTANT CONSIDERATIONS IN STREET PAVING.

By W. L. Dickinson, Supt. of Streets of Springfield, Mass.

THE proper pavement for use in the streets of a city is a subject which is receiving a large amount of public attention at the present time in all sections of the country. Street officials are constantly receiving letters of inquiry from city and town officials as to the method employed in their city, also their opinion is asked what pavements and method they consider the best. When you ask this question of an official familiar with street work, you are asking a question that requires careful study and consideration. The successful business man, before he makes a change or new departure in his business, makes a thorough investigation and carefully weighs each point in detail; so an expert on street works, when he is asked the serious question, what is the proper pavement for the streets of a city, must make a careful examination and study of the city in which he is expected to give his opinion. He should be acquainted with the natural foundations, whether it is quicksand, clay, red marl, sharp sand, etc.; also be familiar with the actual traffic on every street in the city, and carefully study into the future developments of the city in order to satisfy himself of the streets that will be the main arteries leading into these new districts.

In other words, the foundation of a road-bed and the traffic on the streets, has everything to do with the cost and kind of pavement that should be put in on different streets.

It is not economy or common sense to adopt one kind of pavement for every street regardless of the traffic whether heavy or light. It will also make a difference whether the street is wide so that the travel will be distributed over a large space, or has a car track in the center to throw the travel into a narrow channel each side. Car tracks in the center of a street of ordinary width will in a short time destroy almost any pavement, so the most substantial is none too good. If a street is excessively shady it will make quite a difference in the life of a pavement, as shade, water, and a poor foundation are death to all pavements.

Familiarity with different varieties of pavements, what the life of each is under any or all conditions, and a general knowledge of the manufacture of these pavements is necessary in all cases. An exclusive knowledge must be attained of granite and stone from various quarries and what it will do when subjected to traffic, whether it is durable or if it will wear smooth and slippery or not. It will not be well for the reputation of an official to recommend a pavement that simply looks well and takes the eye of the public for a time, but he should advise something that will stand the traffic on every street for a long time for the least possible cost. He must be able to draw proper specifications for the construction of these pavements, which requires time and careful study; the best will not stand if improperly constructed.

When possible a smooth pavement should be recommended, because it saves the wear and tear on horses and vehicles—the saving is estimated, by good authority, to exceed one cent per mile on every vehicle passing over a smooth pavement. It reduces very greatly the power required to haul loads along the street and thus effects a great saving of horse power. It also increases the actual and rental value of real estate. A smooth pavement is beneficial to health. Physicians and health authorities are beginning to recognize and appreciate the injurious effect of street noise on the health of city residents. No one who has lived or done business on an ill-paved street need be told of the discomfort and annoyances of noisy pavements.

Years of experience have already demonstrated the necessity of making a wide difference in treatment between streets of very heavy, moderate and light traffic or residential streets. The essential requisites for the pavements of streets with a very heavy traffic are solidity, durability, and capacity to withstand the constant strain of the heaviest and most crowded wagon traffic. It does not require much research or deliberation to determine that pavements of granite blocks of the proper dimensions and quality and with proper foundations meet these requisites more fully than any other known pavement. For streets of moderate traffic the need of less noisy pavements has long been felt; but the selection of a pavement which will, in the highest degree, combine these qualities with durability and economy of construction, presents greater difficulties. However, the field of choice is practically limited to sheet asphalt and vitrified brick. Great care must be taken in the use of asphalt and brick to secure the right material and construction. With proper care good results are sure to follow.

For light travel or residential streets, macadam, asphalt blocks, sheet asphalt and vitrified brick pavements should be used. Wood pavements have been used for residential streets, but the result of extensive experiments made with wood pavements in different cities have proved so disastrous as to create disgust and lasting disfavor. The character and style of pavements having been determined, the next and most important step is to devise a well defined and comprehensive plan in the selection of the streets to be paved, a plan which, in its gradual development, will progressively meet the necessities of the situation; namely, the creation of an inter-communicative network of firm, hard and durable

pavements in the commercial centers, and connections made with the residential sections of the city with a network of clean, smooth, and noiseless pavements.

RAPID WORK IN LAYING PAVING BRICK.

MR. M. E. SHOEMAKER, foreman of paving at Carlinville, Ill., says an average laborer will lay 15,000 brick per 10 hours when the surface is prepared ready for receiving the brick. He says Pat Murphy, an expert brick paver, will lay 20,000 per 10 hours; at one time he laid 13,428 brick in 4 hours 28 minutes, or at the rate of 30,060 per 10 hours. This is simply laying the brick and, of course, does not include preparing the surface or delivering the brick.

From Monday, Sept. 19, 1 P. M., to Tuesday, Sept. 20, 4 P. M. (13 hours), nine men under unfavorable circumstances, prepared the surface and laid 37,000 brick and covered the last course with sand. This includes all the work of laying the pavement except sweeping in the sand on the top course. This is 3,162 brick per man per 10 hours, nearly completed pavement, or 6,324 for a man and one helper in 10 hours.

PERSONAL.

Mr. W. D. Harris has been appointed highway commissioner of Olneyville, R. I.

Edgar Marburg, Esq., lately bridge engineer with the Carnegie Steel Company, Limited, has been appointed acting professor of civil engineering at the University of Pennsylvania.

Mr. S. M. Allis, of Malden, Mass., has resigned his position as superintendent of water-works, at Malden, Mass., and has accepted a position with the Kinsman Block Signal Co., at Chicago, Ill.

Prof. Lewis M. Haupt, for twenty years professor of civil engineering in the University of Pennsylvania, has resigned his position in order that he may devote his whole time to certain state and municipal works, upon which he is engaged.

Mr. W. S. Hamilton, of Youngstown, Ohio, has resigned his position of superintendent of the city water-works and will probably take a position with the Ohio Steel Co., of Youngstown. Mr. Hamilton has been connected with the water-works since it was built in 1872.

RECENT LEGAL DECISIONS.

Liability of City for Engineer's Act.—A city is liable for injuries caused by an obstruction in a sewer which was placed there under the supervision of the city engineer, or of which he had actual or constructive notice. (Kinsel & Co. *v.* Ogden City. Supr. Ct. Utah, 30 Pac. Rep., 758.)

A City's Authority Over Street Grade.—A city council having general authority to establish the grades of streets may, under peculiar circumstances, fix the grade for one side of a street on a materially different level or place from that of the other side; and if this renders it incidentally necessary to construct a retaining wall along the center of the street to support the earth on the higher grade, that may be done. Such an exercise of public rights is not an infringement of the rights of an adjacent proprietor, whose property may be injured thereby. (Yanish *v.* City of St. Paul. Supr. Ct. Minn., 52 N. W. Rep., 925.)

Submission of Disputes to Engineer.—The two parties to a contract having agreed, in case of disputes or differences as to the construction of their contract, or the sufficiency of the performance of any of the work to be done under it, or the price to be paid, to submit them to the civil engineer in charge, who was to consider and finally decide them, are bound by the measurements made, and by the decision of the selected arbitrator. But the hasty utterances of the arbitrator, without knowledge of all the facts, can not be construed as modifying or changing the terms and conditions of a contract, one of the clauses of which reads: "No extension of time or alteration of this contract is in any way to be considered or allowed, unless the same be in writing, properly signed by the parties and attached to the agreement." (O'Donnell *v.* Forrest, Supr. Ct. La., 11 Southern Rep., 245).

NEW PATENTS.

MR. V. H. LOCKWOOD, patent attorney and solicitor, No. 60 East Market street, Indianapolis, furnishes us the following list of patents of recent date of interest to our readers. Copies can be procured of him if desired:

Street Sweeping Machine. No. 482,663. A. Voelke, New York City.

Brick. No. 483,105. L. H. & H. H. DeFernelmont, Detroit, Mich. Assignors by mesne assignments to L. H. DeFernelmont.

Building Block. No. 482,890. C. Gruenzweig. Assignor to Gruenzwig & Hartman, Ludwigshafen-on-the-Rhine, Germany.

Roller for Clod Crushers or Pulverizers. No. 483,007. C. H. Noblet, Bucyrus, O. Assignor of one-half to H. Albright, same place.

Combination Road Roller. No. 482,757. R. C. Ruthven, Buffalo, N. Y. Assignor to Barber Asphalt Paving Co.

Brick Machine. No. 482,248. H. Harlan, Renovo, Pa. Assignor to himself and G. R. McCrea.

Brick Machine. No. 482,252. G. T. Jacobs, Washington, D. C.

Street Sweeping Machine. No. 482,196. S. H. Rathburn, Stanberry, Mo.

Trench Excavator. No. 482,260. A. J. Mason, Kansas City, Mo.

Apparatus for Purifying Sewage. No. 482,052-53 (two cases)., J. Wilson, New York, N. Y. Assignor to R. Debes, same place.

Draw Bridge Guard. No. 482,291. F. Boncher, Fond du Lac, Wis. Assignor to P. T. Corbeille, same place.

Iron Bridge. No. 482,017. H. A. Loomis, Springfield, Ark.

Tile. No. 483,180. H. Sturm, Paris, France.

Pneumatic Sewerage System. No. 482,439. C. T. Liernur, Berlin, Germany.

Underground Trolley. No. 482,506. J. Fischer, Cleveland, O.

Drying and Disintegrating Clay. No. 482,825. F. D. Cummer, same place.

Electric Conductor Joint. No. 483,074. J. J. Marsh, Pittsburg, Pa. Assignor to Standard Underground Cable Co., same place.

Excavating Device. No. 483,004. T. McBride, Philadelphia, Pa., and E. Fisher, Kincardine, Canada.

Insulated Electric Wire. No. 482,753. T. L. Reed, Providence, R. I.

Conduit for Electric Railways. No. 482,719. F. O. Blackwell. Assignor to Thomson-Houston Electric Co., of Connecticut.

Electric Railway Conduit. No. 482,964. R. M. Hunter, Philadelphia, Pa. Assignor by mesne assignments to Thomson-Houston Electric Co., of Boston, Mass.

Closed Conduit for Electric Railways. No. 482,993. L. P. Bunce Minneapolis, Minn. Assignor of one-eighth to W. Heggum, same place.

Pipe Coupling. No. 482,922. R. Herman, Crafton, Pa.

AN EXHIBIT OF ROAD MACHINERY IN GEORGIA.

To the Editor of Paving and Municipal Engineering:

SIR—The subject of road building is attracting much attention in the south and especially in Georgia. In response to what seems to be a public demand on this question, the State Agricultural Society of Georgia has established a "Department of Roads" at the approaching state fair and offers the following premium: For the best display of road working tools and implements, $100 in gold; this display to consist of rock crushers, road machines, rollers, road scrapers, carts, wheelbarrows, picks, shovels, etc.

There will be in attendance at our fair a large number of practical men, road builders, state and county officials, from this and adjoining states. These visitors will attend the fair for the double purpose of inspecting and purchasing road machinery.

The power, and the rock or stone will be furnished free to any person or company who may desire to place on exhibition a rock crusher and operate the same during the fair. There will be no charge for space or entrance fees, but every facility and convenience will be offered to exhibitors. The fair opens October 25th, closes November 4th, 1892. Very truly yours,

W. A. HUFF, Sup't Road Dep't, Georgia State Fair.

Macon, Ga., October 1, 1892.

Improvement and Contracting News.

PAVING.

Second street, Dunkirk, N. Y., is to be paved with brick.

The public square at Canton, Ill., will be paved with brick.

Ten additional streets will be paved with vitrified brick at Omaha, Neb.

Michigan City, Ind., is replacing her sandy paths with cement walks.

A cedar pavement will be laid on Washington street at Bay City, Mich.

A $5,000 roadway is being built in McMillan's addition at Portland, Ore.

Charleston, Ill., will hereafter use vitrified brick in paving the roadways.

Atlantic avenue, from Vine to Kibby streets, Lima, Ohio, will be graded.

Augusta, Ga., has decided to put down asphalt on the whole of Broad street.

As an experiment, Milford, Ill., will macadamize one block of her main street.

Hancock, Mich., has spent $50,000 this year on street and sewer improvements.

Oak Park, one of the suburbs of Chicago, will use vitrified brick for street paving.

There are, in Marion county, Indiana, twenty-five miles of roads on which toll is taken.

At Superior, Wis., North Twelfth street has been ordered paved from John to Oak avenues.

Washington street, at Portland, Ore., has been paved with bituminous rock out to the City Park.

Des Moines, Iowa, is paving East Capitol street with brick, from Eleventh to Eighteenth streets.

A new road is to be built a distance of four miles from Oneida to Hopeville, Pa., by Coxe Bros. & Co.

The town council of Ambler, Pa., has decided to macadamize Lindenwold avenue a distance of 1,500 feet.

Bids have been received for paving Moselle, Grimes, Lewis, Kehr and Brighton streets at Buffalo, N. Y.

Third avenue is paved with brick to the viaduct at Rock Island, Ill. The Rockford Construction did the work.

Grading, curbing and brick paving will be done in District No. 11 at Lincoln, Neb. Bids have been advertised.

Tenth street, from Maple to Angular streets, at Burlington, Ia., will be graded, curbed, and paved with brick.

Third avenue, Duluth, Minn., from Grand avenue to the boundary of the 6th division, is being macadamized.

The common council of Albany, N. Y., has appropriated $10,000 with which to get the city in good sanitary condition.

Some brick paving is being done at Hannibal, Mo., and macadam is being used for the under course instead of soft brick.

The village of South Mt. Vernon, N. Y., has appropriated $22,000 for the purpose of macadamizing the White Plains road.

The city council of Boone, Iowa., has ordered the city clerk to advertise for bids for paving and curbing the business streets.

Gen. J. S. Fullerton is still urging the board of public improvement to give paving brick a trial on the streets of St. Louis, Mo.

The common council of Binghamton, N. Y., has decided to pave a portion of State street with brick by way of an experiment.

No paving will be done at Sterling, Ill., until spring. Contracts have been let for macadamizing Second avenue and grading First avenue.

An asphalt mine is being developed at Uvalde, Texas, seventy-five miles west of San Antonio. About twenty-five men are at work in the mine.

Macadam and new sidewalks are to beautify Comstock street, at Wabash, Ind., from the north line of Ferry street to the south line of Stitt street.

Four million hard brick for street paving have been shipped into Indianapolis and it will require another million to complete the contracts now out.

The New York Brick and Paving Co., of Syracuse, N. Y., will lay a brick pavement on a street at Springfield, Mass., and guarantee the work for ten years.

A new highway sixty feet wide and two and one-fourth miles long is wanted by the principal land-owners between Chicopee Falls and Willimansett, Mass.

Wayne street, Kenton, Ohio, is to be improved from the north side of Espy street to the south side of Brunun, by grading, guttering and graveling same.

The village officers of Cuba, Ill., have macadamized 1,200 feet of Main street and put in 2,000 feet of sidewalk and will yet put down 1,000 feet more this fall.

It has been decided to use vitrified brick for street paving at Fremont, Ohio, and bids will be opened Oct. 17th for the paving of Main street with that material.

Dayton, Ohio, will grade and gravel the sidewalks, curb and pave gutters and grade and gravel the roadway on portions of Hart street, Franklin street and Stanley street.

It is the intention of the city council of Elizabeth, N. J., to improve Erie street, from First avenue to Third avenue, by grading, curbing, guttering and flagging.

The village of Blue Island, Ill., will improve Western avenue from Stony Creek to Burr Oak avenue, by placing stone curbing and a cedar block pavement thereon.

At Corning, New York, Pine street, between Erie avenue and First street, is being paved with brick. They are laid on a bed of concrete with the long narrow edge up.

It has been decided by the board of trustees of Venice, Mo., to improve Main street the entire length, 2,793 feet, by grading, paving and guttering; all to cost about $25,000.

We are informed by the city engineer of Quincy, Ill., that bids will be advertised this fall for ten blocks of paving to be laid next spring. The estimated cost is about $50,000.

Second street, Marietta, Ohio, is to be curbed on each side of the roadway, graded and paved with brick from the southerly line of Putnam street to the northerly line of Butler street.

Benton Harbor, Mich., will pave Main street between Sixth and Seventh streets; Pipestone, from Main to Pleasant streets, and Water street, from Main to Fifth, with sapless cedar blocks.

The city of Boone, Ia., will receive proposals until October 20 for paving with brick, Story street, from the C. & N. W. R. R. to Seventh street, and Eighth street from Arden to Runyon streets.

Monument avenue, from Main to Wilkinson streets, and Ludlow street from Monument avenue to Third street, at Dayton, Ohio, will be paved with sheet asphalt this fall by the Warren-Scharf Co.

The residents on South Main street, below Oak, at Shenandoah, Pa., are very enthusiastic over the street paving question and are desirous of having a Belgian block pavement laid on that thoroughfare.

The demand for street paving brick in Illinois is so great that the manufacturers are totally unable to meet it. Many contractors refuse to bid on work, owing to the difficulty in obtaining material.

Some 100 or more streets and alleys are to be paved under recent ordinances passed at Chicago, Ill., and Commissioner Aldrich says he he hopes to have the entire number put in good condition before cold weather.

The McMinnville & Nestucca Road Co. has been incorporated for the purpose of building a wagon road from McMinnville, in Yan Hill county to Nestucca in Fillamook county, Ore. The capital stock is fixed at $10,000.

At Columbus, Ohio, Fourth street, from Crittenden to Maynard avenues, is to be paved with Hayden block. Mr. L. C. Newsom will do the work, in consideration of $66,461.80. There are 22,000 yards of pavement to be laid.

When the muddy season approaches, it will find the principal streets of Monmouth, Ill., transformed into clean and well-paved boulevards. Broadway, West Fourth avenue and East Second avenue are being paved with brick.

First avenue, Evansville, Ind., is graced by a new brick pavement. The contract is completed and the street open to traffic. Evansville now has six and one-half miles of brick-paved streets, and before the season is over it will have ten miles.

Veiths & Skrainka were awarded the contract for paving West Broadway, East St. Louis, Ill., and when completed the street will be one of the finest in the city. It will be paved with granite from C street to the viaduct, and will cost $25,000.

The estimates and contracts in the office of the city engineer of Omaha, Neb., show that fully $550,000 of public work is now under contract, with a large portion of it completed. This work consists of nearly five miles of new paving, several miles of sewers, and nearly ten miles of grading and a mile or more of permanent sidewalk.

The principal streets of Xenia, Ohio, will be paved with brick and the expense assessed upon the property owners, with the privilege of paying for the same within the next fifteen years. Bonds will be issued and the work commenced in a short time.

Steps have been taken to make sure that the paving contracts on the principal thoroughfares of Detroit, Mich., will be finished by November 1. Work is carried on Sundays and nights, and the city furnishes the necessary electricity to do it, free of charge.

The members of the St. Louis Paving Brick Co. met recently in Galesburg, Ill., on business relating to the establishing of another paving brick factory there. The stockholders of the company represent $15,000,000 or $16,000,000 and varied brick interests.

The macadamizing of Bathgate and Morris avenues at Westchester, N.Y., has been ordered and the work will soon be begun. Bathgate avenue will be improved from 172d street to Third avenue and Morris avenue from the Harlem railroad to Fleetwood Park.

The improvement of Washington street at Alexandria, Va., is being discussed. It runs north and south two miles and is in a direct line with the road to Washington. A majority of the larger property owners on it are in favor of either macadamizing it or laying it with asphalt.

The matter of street paving for Crawfordsville, Ind., came up before a special council meeting, and if the spirit of the meeting is to be taken as a criterion, it is not improbable that before many moons the streets of that city will undergo the beginning of a great revolution.

Proposals have been opened and contracts let for re-paving twenty-three streets in Brooklyn, N. Y. William Kelley received nine street contracts, aggregating $363,504; Norton & Gorman, twelve contracts, aggregating $173,094.95, and J. F. Gillen, two contracts aggregating $39,024.50.

The council committee on streets at Toledo, Ohio, have approved ordinances to pave Nebraska street, from Junction ave. to Hoag street; from Hoag street to Hawley street, and from Hawley street to Elizabeth street. Bids will also be received until October 17th for improving Door street. from Lenk street to White ave., and Walnut street from the paving in Bancroft street to Seneca street. The paving is to be done with either Medina stone, cedar blocks, vitrified bricks, asphalt blocks or Trinidad asphalt, together with necessary grading, curbing, guttering, cross-walks, drainage, etc.

The following named streets are to be graded and macadamized at York, Pa.: Princess street, from Cedar to West street; Cedar street from King street to New Salem road; Grant street, from Clark alley to Cottage Hill road; King street, from West street to Belvidere avenue; Hartley street, from Princess street to College avenue; Belvidere avenue, from Market street to Philadelphia street; west half of Newberry street, from North street to Park street; Linden avenue, from West York to West street; Park Place; Belvidere avenue, from King street to New Salem road, and South street, from Queen street eastwardly to the city limits.

Wilmette, Ill., does not propose to be left in the lurch, as far as having paved streets is concerned. The water and sewerage question has been settled, and the landholders have signed a petition asking that an ordinance be prepared providing for an asphalt pavement on portions of North avenue, Elm street, Lake avenue, West avenue, James street, Lincoln avenue, Hill street, Sheridan road, Central avenue and State street.

Resolutions have been approved by the board of public works of Kansas City, Mo., to pave Brooklyn avenue from Twelfth to Fifteenth streets, with vitrified brick; Annie street, from Garfield to Brooklyn avenues, with asphalt; Michigan avenue, from Tenth to Twelfth with vitrified brick; Ninth street, from Oak street to Forest avenue with asphalt, and the alley between Troost and Forest avenues, from Thirteenth to Fourteenth streets, with vitrified brick.

SEWERS.

The city of Fargo, N. D., will have a system of sewerage.

Millville, N. J., is now agitating the sewerage question.

Oswego, N. Y., will spend $100,000 in sewerage this fall.

Several additional sewers have been ordered at Troy, N. Y.

Cleveland, Ohio, will have over one hundred miles of sewers.

Plans for a sewerage system for Oconto, Wis., have been prepared.

At Newark, Ohio, a tile sewer will be built in Buena Vista street.

J. A. Clark has been awarded an $8,000 sewer contract at Colfax, Wash.

M. J. Condon & Co. are constructing the sewer system at Knoxville, Tenn.

A system of 12-inch vitrified pipe sewers will be built at Norwood, Park, Ill.

The council of Chester, Pa., has voted to construct sewers in several streets.

A system of sewers about a mile in length will be built at Fargo, N. D.

Andrew Sheridan is building the Mitchell avenue sewer at St. Joseph, Mo.

Detroit, Mich., is engaged in constructing a large number of lateral sewers.

A sewer will be built in Wood street in sewer district No. 1, at Fremont, Ohio.

It is said that the sewerage of Brooklyn, N. Y., will cost over $2,000,000 this year.

It has been voted to bond Montesano, Wash., for a sewerage system to cost $15,000.

McKeesport, Pa., will put in sewers on Fifth avenue, which will cost about $80,000.

At Huntington, Ind., bids are asked until Oct. 24th for the Flint Creek sewer and drain.

Final estimates for sewers at Cincinnati, Ohio, amounting to $100,000, have been approved.

Marine City, Mich., is putting a system of sewerage in at a cost of $20,000. When completed, the system will be first-class in every particular.

Fremont, Neb., has let the contract for the putting in of a sewer system that will cost $29,830.

A new twenty-inch sewer is to be laid at La Crosse, Wis., on Third street from Pearl to Cass streets.

The city council of Concord, N. H., has voted a sum, not exceeding $20,000, for sewer extensions.

A sewer will be constructed in Detroit street, at Cleveland, Ohio, with an outlet to the Cuyahoga river.

The township committee at Linden, N. J., is taking steps to insure a sewerage system for the township.

W. A. Camplin was awarded the contract for constructing a sewer in Alley No. 169, at Nashville, Tenn.

The question of issuing sewer bonds for $100,000, at Omaha, Neb., will be voted upon at the November election.

The citizens of Wilmerding, P., have voted to issue bonds for $75,000 for sewers and street improvements.

The three-foot brick sewer on North Michigan and Hamilton streets at Racine, Wis., has been completed.

The contract for sewers in Beaver street at Sewickley, Pa., has been awarded to Corcoran & Connell, of Pittsburg.

Prout, Burnham & Russell, of Wheaton, Ill., have prepared plans for a system of sewers for Lombard, Ill., to cost $20,000.

It is quite probable that the work on the east side sewer system at Aurora, Ill., will not be commenced before next spring.

The city council of Salt Lake City, Utah, ordered an addition of about one and one-half miles to the sewerage system of that city.

The most important improvement made this year in Grand Rapids, Mich., is a large sewer 4 feet in diameter and 1,000 feet long.

Lynch Brothers were awarded the contract for the Lyman street sewer, at Holyoke, Mass., at a bid of $13 per thousand brick.

At a meeting of the residents of the village of Kingston, N. Y., it was agreed that a system of sewerage should be introduced.

The council of Bay City, Mich., has voted to construct a brick sewer in Eighteenth street to the river. It will be 26 x 39 inches.

Plans and surveys are being made by Mr. McWillie, city engineer of Denison, Texas, for sewer extensions to cost about $11,000.

Miller & McDougal, who took the contract to construct a system of sewers for Hornellsville, N. Y., have discontinued their contract.

The city engineer of Oakland, Cal., estimates that the proposed five-foot sewer in Second avenue, will cost over $45,000. The length is 2,278 feet.

The city clerk of Terre Haute, Ind., will receive bids until Oct. 18th for improving Fourteenth street, including the construction of a sewer therein.

Cobleskill, N. Y., is to have a sewerage system to cost about $16,000. W. M. Johnston, of Canajoharie, and C. E. Walker, of Amsterdam, will build same.

Lynn, Mass., has appropriated $5,000 to improve its sanitary condition. All the house offal is to be dumped three miles out at sea.

The contract for section 5 of the east side sewer at Rochester, N. Y., has been awarded to Lauer & Hagaman at $93,077 for the brick arch.

James H. Harlow & Co., of Pittsburg, were awarded the contract for a complete system of sewerage for Wilkinsburg, Pa., at a cost of $140,000.

The city council of Negaunee, Mich., will spend about $6,000 on the proposed sewer in the southern part of the city and finish the work next year.

A new sewerage commission has been appointed at San Francisco, Cal., as the initial step in the matter of providing a new sewer system for that city.

The council of Mexico, Mo., has decided upon a sewer system. The pipes will be twenty-one inches in diameter and construction will begin at once.

Plans have been prepared for a sewerage system at Muskegon, Mich., to cost about $10,000, and the main sewer is to be constructed this fall and winter.

Messrs. Edwards & Walsh will construct the Marquette street sewer at Davenport, Iowa. It will be egg-shaped, built of brick and the contract price is $14,000.

Galveston, Texas, has granted a franchise for a sewer system and plans and specifications are being prepared. It is proposed to sewer the entire city.

An ordinance has been presented to the council of Manchester, Va., granting the right to construct, operate and maintain a system of sewerage in Manchester.

A vitrified sewer will be laid at Winona, Minn., on Olmstead street, from Sanborn street to the lake and one also on King street from Grand to Olmstead streets.

R. S. Reilly was the lowest bidder for the sewers in the east side, Portland, Ore. The system will be about four miles in length and includes 2,500 feet of brick sewers.

Special committees from Kansas City, Mo., and Kansas City, Kan., are arranging for the construction of a sewer to drain the west bottoms. Estimated cost, $16,000.

A lateral tile sewer will be constructed on Circular street, from Monroe street to Sycamore street, at Tiffin, Ohio. Also a main and lateral sewer in main sewer district No. 17.

Work on the main sewer and extensions at Great Falls, Mont, is progressing nicely, and when completed, Great Falls will have one of the finest sewerage systems in that section of the country.

A sanitary engineer of Columbus, Ohio, has entered into a contract with the sewer committee of the council of London, Ohio, to prepare plans and specifications for the construction of a system of sewerage for that city.

Plans will soon be submitted for a complete sewerage system for New Orleans, La. Engineers have been at work several months. Dr. Joseph Holt has been elected president of the New Orleans Sewerage Co., which was organized the 15th of last month for the purpose of acquiring the franchise granted by the city to A. A. Woods, and of constructing and operating the sewerage system therein provided for.

Anderson Bryan has the contract for the big sewer on State street, at Des Moines, Iowa. It is a big job, upon which not less than 300 men are employed, and in many places the depth of the main sewer is twenty feet.

The sewer commission of Batavia, N. Y., has contracted with J. W. Holmes to make surveys, estimates and specifications for a system of sewerage. It is proposed to issue bonds for $300,000 for the construction of a complete system.

A report on the sewerage system for Woonsocket, R. I., has been made by a committee from the city council and board of aldermen. The report includes special reports by engineers at Worcester, Mass., Providence, R. I., New York, Woonsocket, R. I., and Lawrence, Mass. After Chas. A. Allen and Shedd & Sarle, of Worcester, had made their reports, they joined in a supplementary report and the sewerage committee recommended the adoption of a system as recommended in the joint supplementary report.

WATER-WORKS.

Fremont, Neb., will extend its water-works system.

A system of water-works will be built at Marshall, Mich.

Cumberland, Wis., is agitating the question of water-works.

Water-works are to be constructed in Naperville, Ill, at a cost of $100,000.

It is estimated that water-works can be built at Meredith, N. H., for $35,800.

It is estimated that water-works can be built at East Syracuse, N. Y., for $70,000.

An appropriation of $55,000 has been made at Pembroke, Ont., for water-works.

A stand-pipe and direct pressure system of water-works will be built at Rochester, Ind.

The water-works question has been favorably voted upon at North Manchester, Ind.

Newport, R. I., proposes to increase its water supply by using lower Easton's pond.

The Bowling Green (Ohio) Water Company has been incorporated with $75,000 capital.

The Aiken Water Company has been incorporated at Aiken, S. C., with $60,000 capital.

Chester, N. Y., will have water-works. The vote was sixty-eight for and seven against.

The citizens of Shreve, O., have voted to bond their town to the extent of $8,000 for water-works.

Mr. A. S. Wright is superintending the construction of a system of water-works at Wheatland, Ia.

The town of Boonton, N. J., has appropriated $100 for a survey of possible source of water-works.

The new water-works at Plymouth, O., will cost about $30,000 and will soon be in running order.

A contract for water-works at Marietta, Pa., has been awarded to J. F. Stauffer & Son, of Lancaster.

The deepest artesian well in the world penetrates to the depth of 4,194 feet, near Berlin. The next deepest is 3 843½ feet, at St. Louis, Mo., and third in the list is a well 3,553 feet in depth, at Titusville, Pa.

The town of Fairmont, W. Va., has new water-works that supplies the town with an abundance of fresh water.

The city engineer has estimated the cost of material for new city water-works for Winnipeg, Can., at $108,750.

On November 8th, the people of Hanover, Pa., will vote on buying the works of the Hanover Water Company.

A 24,000,000 gallon vertical pump will be added to the water-works system of Detroit, Mich., at a cost of $90,000.

A contract to build water-works at Fayetteville, N. Y., has been awarded to Col. M. B. Birdseye, at his bid of $26,357.25.

James Reese & Co., of Pittsburgh, will place a new battery of boilers in the water-works at McKeesport, Pa., at a cost of $4,100.

The town of Waitsburg, Wash., voted on bonding the city in the sum of $28,000 for water-works and was carried by eight to one.

The citizens of Linwood, O., will vote on the water-works question, which, if carried, will involve the expenditure of $40,000.

Moffett, Hodgkins & Clarke, of New York City, have been awarded the contract to build water-works at Carthage, N. Y., for $46,500.

The town of Florida, N. J., will soon have a fine system of water-works. The water is supplied from Glenmere Lake and will cost $30,000.

In a short time the city of Dayton, Ohio, will be supplied with water from seventy driven wells, ten new ones being added to the present number.

Ludlow, Ky., will get its water supply from Covington for twenty years to come. The laying of pipes will be done at the cost of the Ludlow citizens.

The water company at Jamestown, N. Y., is extending its water-works by laying mains and constructing a reservoir and pumping station on Buffalo street.

Forty thousand dollars is the estimated cost of a water-works system and electric light plant at Reading, Ohio. Plans have been made by T. A. Burch. A vote on building the works will be taken in November.

BRIDGES.

A new iron swing bridge is to be erected at Mackinaw, Mich.

A new iron railroad bridge spans Rock River at Oregon, Ill.

A new bridge will be built over Clarks Fork, near Yorkville, S. C.

A new iron bridge is being placed across the Shiawassee at Henderson, Mich.

An iron bridge will be built across the Great Miami river south of Miamisburg, Ohio.

W. H. Converse, of Chattanooga, has the contract to build a bridge across Red river at Clarkesville, Tenn., at a cost of about $10,000.

It has been decided by a vote of six to four in the city council of St. Cloud, Minn., to build the new Mississippi river bridge at that place. The bridge is to be 28 feet wide, of solid iron and to cost $47,000.

The county clerk of Helena, Mont., will receive bids until Oct. 20th for an iron combination bridge over the Dearborn river near the Roberts' place; also an eighty-foot span with iron piers on Prickly Pear.

The contract for reflooring the Rock Island bridges at Rock Island, Ill., was let at a bid of $20,500.

Reynolds & Slattery were awarded the contract for constructing a bridge over Rattle Snake Creek near New Richmond, Ind.

A $7,000 wagon bridge, 370 feet long, will be built by the county commissioners of Skagit county, Wash., across Baker river.

The new bridge at Endora, Kan., 1,400 feet long, is completed and the board of county commissioners is well pleased with it.

S. S. Fairfield, of La Salle, Ill., has been awarded the contract for building a bridge over the Pequamsoggen this side of La Salle.

The cost of the Chicago, Milwaukee and St. Paul railway bridges along its line from Stillwater to Hastings, Mich., was $80,000, and are completed.

The erection of a new iron bridge at Seeley, N. J., at a cost not to exceed $1,250, has been authorized by the Cumberland county board of freeholders.

Messrs. William Rennie and D. K. Campbell have been awarded the contract for building the government bridge across the Squamish river at Vancoover, B. C.

The city engineer of Springfield, Ohio, was directed to prepare plans and specifications for the erection of a steel bridge on Lagonda avenue over Lagonda creek.

On September 20th the southern abutment of the new bridge across the Mississippi river at Alton, Ill., was completed, and work is now in progress on the piers.

The contract for the construction of the Town street bridge at Columbus, Ohio, was awarded to Cook, Grant & Cook, at their bid, amounting in the aggregate to $18,729.

The work on the new suspension bridge at Sixth street, to connect Pittsburg and Allegheny, is now making rapid progress, and it is expected to be opened by December 15th.

Bids will be received at Troy, Ohio, until October 21st for building a ten span, high truss iron bridge over Stillwater river, about one and one-half miles north of Covington.

The annual estimate of the bridge department for 1893 at Minneapolis, Minn., has been completed by F. W. Cappelan, chief of the department, and is found to aggregate $155,034.

The new high bridge across the Mississippi at Clinton, Iowa, is, with approaches, about a mile in length and cost $146,000. It was two years and nine days in building from the time the first pile was driven. It is now open to traffic. This makes a total of three steel bridges across the Mississippi river within two miles.

STREET LIGHTING.

Roanoke, Va., will be lighted by electricity.

At Leesburg, Va., the streets will be lighted by electricity.

The citizens of Hampton, Iowa, have voted almost unanimously in favor of an electric light plant.

The Hamburg Water and Electric Light Co. is preparing to establish a plant in Orchard Park, N. Y.

The Dawson Electric Light, Heat and Power Co. has been incorporated at Dawson, Pa., with $20,000 capital.

The contract for lighting the streets of Kokomo, Ind., has been awarded to the Western Electric Co., of Chicago, Ill.

The N. O. Nelson Manufacturing Company was awarded the contract for lighting the streets of Edwardsville, Ill., by electricity.

The contract with the Hudson Electric Light Co. for street lighting at Hoboken, N. J., has been awarded for a period of ten years.

A franchise has been granted to the Ft. Wayne Electric Light Co., whose capital stock is $100,000, for electric lights for Jackson, Mich.

The Board of Public Works of Muskegon, Mich., will receive bids until October 17th, for not less than 150 lights of 2,000 candle-power each, for five years.

The Sumpter (S. C.) Electric Light Company, has decided to increase the capacity of its plant by putting in a 90-horse-power boiler, and a 75-horse power engine.

San Bernardino, Cal., has awarded the contract for forty or more arc lights, of 2,000 candle-power each, at $11 per light per month, and each light is to burn all night.

The citizens of South Glens Falls, N. Y., have voted in favor of arc electric lights and a contract for eighteen or more has been awarded to the Glens Falls Electric Light Company.

The Imperial Shale Brick Co., of Canton, Ohio; the Anchor Tile and Clay Co., of Canton, Ohio, and the Canton Vitrified Brick Co. have bought the right to use the "Yates" Improved Kiln.

Resolutions have been passed by the city of Providence, R. I., instructing the commissioner of public works to carry out the plan of sewerage and sewage disposal designed by Samuel M. Gray, of that city. His plan contemplates the construction of marginal sewers, pumping and precipitation works, it being the design to first treat the sewage chemically and discharge the clarified effluent into the Providence river, about two miles below the city. The works are estimated to cost upward of $2,000,000.

Ripans Tabules: for sour stomach.

YOU WILL MAKE NO MISTAKE

IF YOU CONTEMPLATE A TRIP TO

Chicago, Milwaukee, St. Paul, Minneapolis or any Northwestern Point,

By purchasing your tickets over the

MONON * ROUTE

L. N. A. & C. R'Y.

The New Management having entirely rebuilt the line, putting in over 300,000 new ties, miles of new steel, new iron bridges, etc., etc. This, in connection with elegant **Pullman Perfected Safety Vestibule Trains,** composed of DAY COACHES, PARLOR and DINING CARS (the only line running Dining Cars between Indianapolis and Chicago), and Pullman Buffett Sleepers, makes this

THE LINE between Indianapolis and Chicago, also the Short Line, only 183 Miles Indianapolis to Chicago.

Be sure and purchase your tickets via the

GREAT MONON ROUTE.

Ticket Offices, 26 South Illinois Street, Massachusetts Avenue and Union Station.

JAMES BARKER, G. P. A., Chicago. I. D. BALDWIN, D. P. A., Indianapolis.

UNEQUALLED BUCKEYE Portland CEMENT of BELLEFONTAINE, O.

Unequaled for all purposes for which Portland Cement is used. Tests and Testimonials of Engineers and a useful pamphlet sent free on application. • •

Buckeye Portland Cement Co. Bellefontaine, Ohio.

New Discovery

DOWN DRAFT KILN

For uniformity of Burning and Economy of Fuel it is

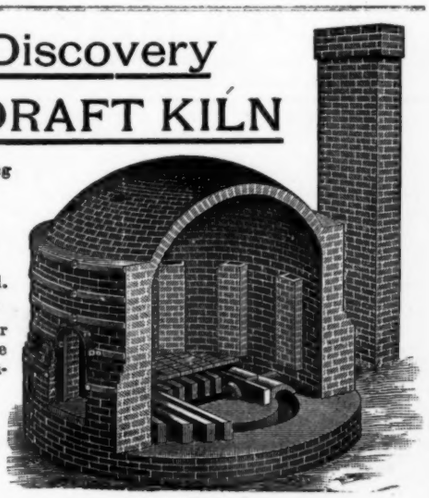
Not Equaled.

Not Expensive to Build. Easily Kept in Repair.

Those interested, write for many testimonials from the leading plants of the country. Address,

E. M. PIKE,

CHENOA, ILL.



PROFESSIONAL CARDS.

The many letters constantly received asking for the names of persons who can give technical advice on municipal work must be answered by the publishers, by referring the writers to this list of competent and reliable Civil Engineers.

ANDREW ROSEWATER, C. E.,
M. AM. SOC. C. E.,
Engineer Municipal Public Works
SEWERAGE A SPECIALTY.
424 BEE BUILDING, OMAHA, NEB.

T H S. R. HASLEY
CIVIL ENGINEER
Surveys, Plans and Specifications for Sewerage and Drainage, Special Attention paid to Paving and General City Improvement. Expert City Surveying, Detail City Maps, Grade Atlases, Construction Superintended.
Main Office at Marinette, Wisconsin.

HIRAM PHILLIPS, C. E.
CONSULTING
CIVIL AND MINING ENGINEER,
810 Olive Street, St. Louis, Mo.
Extended experience in testing all kinds of paving materials, plans, estimates and specifications.

WE PAY CASH
For the June, August, September and October, 1890, and October and November, 1891, numbers of Paving and Municipal Engineering. Drop a card when you send them.
Paving and Municipal Engineering.

SAMUEL M. GRAY,
Consulting Engineer
For Municipal and Sanitary Work.
26 Westminster St., Providence, R. I.

GEO. PAUL, C. E.
Formerly Member Board of Public Works of Ohio
432 Society for Savings Building,
CLEVELAND, OHIO.
SEWERAGE, WATER SUPPLY, MILL DAMS AND OTHER HYDRAULIC IMPROVEMENTS.

S. H. SHEARER,
CIVIL ENGINEER,
Bridges, Sewers, Pavements.
33 Ingalls Block, Indianapolis, Ind.

E. F. LAYMAN,
Civil and Sanitary Engineer,
Rooms 17-18, 64 W. 3d St., Cincinnati, O.
Surveys, Plans and Specifications for Sewerage, Drainage and Water Supply. Special attention paid to Pavements and general city and village improvements; also Surveying of city and suburban property.

RIPANS TABULES regulate the stomach, liver and bowels, and purify the blood; are safe and effectual; the best medicine known for indigestion, biliousness, headache, constipation, dyspepsia, chronic liver troubles, dysentery, bad complexion, dizziness, offensive breath and all disorders of the stomach, liver and bowels. One tabule gives immediate relief. Take one at meal time. Sold by Druggists. A trial bottle sent by mail on receipt of 15 cents
RIPANS CHEMICAL CO., 10 Spruce St., New York.

PROFESSIONAL CARDS.

Pittsburgh Testing Laboratory,
116 Water Street,
PITTSBURGH, PA.
SPECIALTIES—Chemical tests of all kinds; inspection of water pipe; testing of brick and paving materials; inspection of structural material.

LATHAM ANDERSON,
M. AM. SOC. C. E.
Consulting Engineer,
Rooms 49 & 54 Johnston Buildings,
Cincinnati, Ohio.
Sewerage, Water Supply, Municipal Engineering, Landscape Engineering, Construction Superintended.

WILLIAMSON & EARL
Civil and Sanitary Engineers.
Plans and Estimates made for Water Supply, Sewerage, Bridges and General Engineering Work, Railroad Surveys and Construction. Construction Superintended. Sewerage a Specialty.
MONTGOMERY, ALA.

Jas. D. & Miles S. Saunders
CIVIL ENGINEERS AND SURVEYORS
EVANSVILLE, IND.
Surveys, Plans and Specifications on Sewers, Streets and other Municipal Work.
Estimates and Reports on all such work for cities and towns given prompt attention.

BRICK PAVEMENTS
—BY—
C. P. CHASE, Civil Engineer, Clinton, Iowa.
Full instructions from the beginning, with complete specifications.
The most useful and reliable hand book to be obtained. Price, $1.00.

BALTIMORE & OHIO
Southwestern R. R.
SAVED TO
$2 New York and Boston
ALL TRAINS RUN THROUGH
Washington, Baltimore and Philadelphia.
"BEST IN THE WORLD."
The B. & O. Southwestern limited, an entirely new train, Vestibuled, lighted with Pintsch Gas, and has the Anti-Telescopic device, leaves Cincinnati every evening and the New York Express every morning.
THE SHORTEST AND BEST EQUIPPED LINE BETWEEN
CINCINNATI and COLUMBUS
Pullman Parlor and Sleeping Cars,
Time 3¼ hours.
TWO SOLID TRAINS TO **PITTSBURGH**
Via Columbus, Zanesville and Wheeling.
With Pullman Buffet Sleeper and Parlor Cars.
Rates always as low as by any other line, and no extra fare for fast time on limited vestibuled trains.
Ask for tickets via Cincinnati and the B. & O. R. R.
W. W. PEABODY, Vice-President.
O. P. McCARTY, Gen'l Pass. Agt.

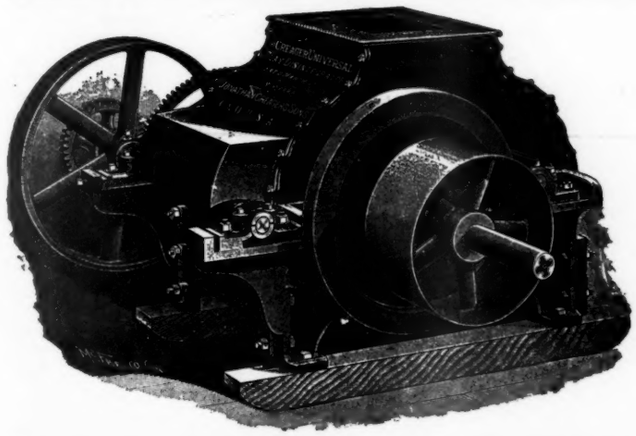
PROFESSIONAL CARDS.

M. AM. SOC. C. E. M. AM. SOC. M. E.
OLIN H. LANDRETH,
NASHVILLE, TENN.
Consulting Engineer.
Water-works, water power, drainage, reclamation, improvement of highways and street paving.
Examinations, expert tests, reports, designs, specifications and estimates.

ARTHUR S. HOBBY,
Civil and Sanitary Engineer
No. 227 Main Street,
Cincinnati, Ohio.
Sewerage Systems for Cities and Villages designed and their construction superintended.
Design and construction of manufactories.
Foundations for heavy buildings, and for engines and machinery.
Foundations in bad ground or in water.

V. H. LOCKWOOD
Patents
SOLICITOR AND COUNSEL
(Successor to CHAS. P. JACOBS)
60 EAST MARKET STREET, INDIANAPOLIS.

Cincinnati Hamilton and Dayton Thousand Mile Books are now sold for Twenty Dollars and good on fifteen different roads all connecting
2 CENTS PER MILE VIA C.H.&D.
An ever-ready ticket between Cincinnati Dayton Chicago St. Louis Salamanca Ft. Wayne Indianapolis Ann Arbor Toledo Buffalo Peoria Cleveland Niagara Falls and a Thousand other points.
Tickets can be purchased at City Ticket Offices, corner Illinois Street and Kentucky Ave., No. 134 South Illinois St. and Union Station, Indianapolis.
H. J. RHEIN, Gen. Agent.



THE CREAGER UNIVERSAL DISINTEGRATORS

Are built in three sizes to prepare clay for 30, 50 and 80 thousand brick per day. Just why you should have them, and why others using inferior Disintegrators can afford to set out the old and set in the

"CREAGER"

Together with all the information you may want on the subject, will be promptly furnished by the manufacturers.

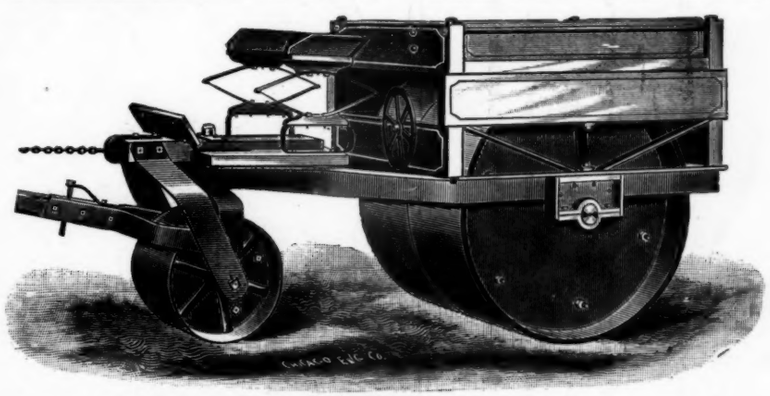
JONATHAN CREAGER'S SONS, Cincinnati, Ohio.

IF YOU KNOW

Any person interested in anything that comes within the scope of this journal, who is not now a subscriber, we would like to have his name and address

WE CAN HELP HIM

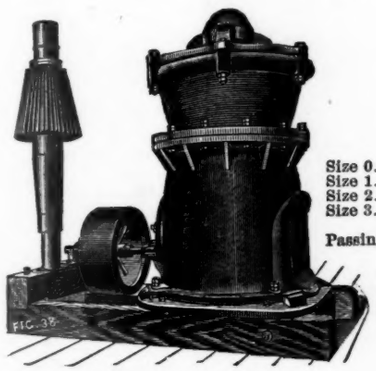
ROLLER FOR STREET PAVING



FOR CATALOGUE AND PRICE ADDRESS ENTERPRISE MFG. CO. 103 MAIN ST. COLUMBIANA, O.

FOR MAKING ROAD METAL USE THE

GATES ROCK AND ORE BREAKER



OVER **2000** IN USE.

CAPACITY IN TONS OF 2,000 POUNDS.

Size 0	2 to 4 tons per hour.	Size 4	15 to 30 tons per hour.
Size 1	4 to 8 tons per hour.	Size 5	25 to 40 tons per hour.
Size 2	6 to 12 tons per hour.	Size 6	30 to 60 tons per hour.
Size 3	10 to 20 tons per hour.	Size 7	40 to 75 tons per hour.
		Size 8	100 to 150 tons per hour.

Passing 2 1-2 in. ring, according to character and hardness of metal.

Great Saving in Power. Adjustable to any Degree of Fineness. The principle involved in this Breaker acknowledged to be the greatest success ever introduced into Stonebreaking machinery. The Gates Breaker has made more railroad ballast and road metal than all other kinds of breakers combined. **Universally Adopted by Mining Companies. Many Hundreds Used by Railway Companies.** Will furnish a thousand references from Contractors, Street Superintendents, Mines, Cement Manufacturers, etc. Also Manufacture

THE CORNISH ROLLS PULVERIZER

Fine Crushing Plants, Concentrators and Other Mining Machinery. Address for Catalogue

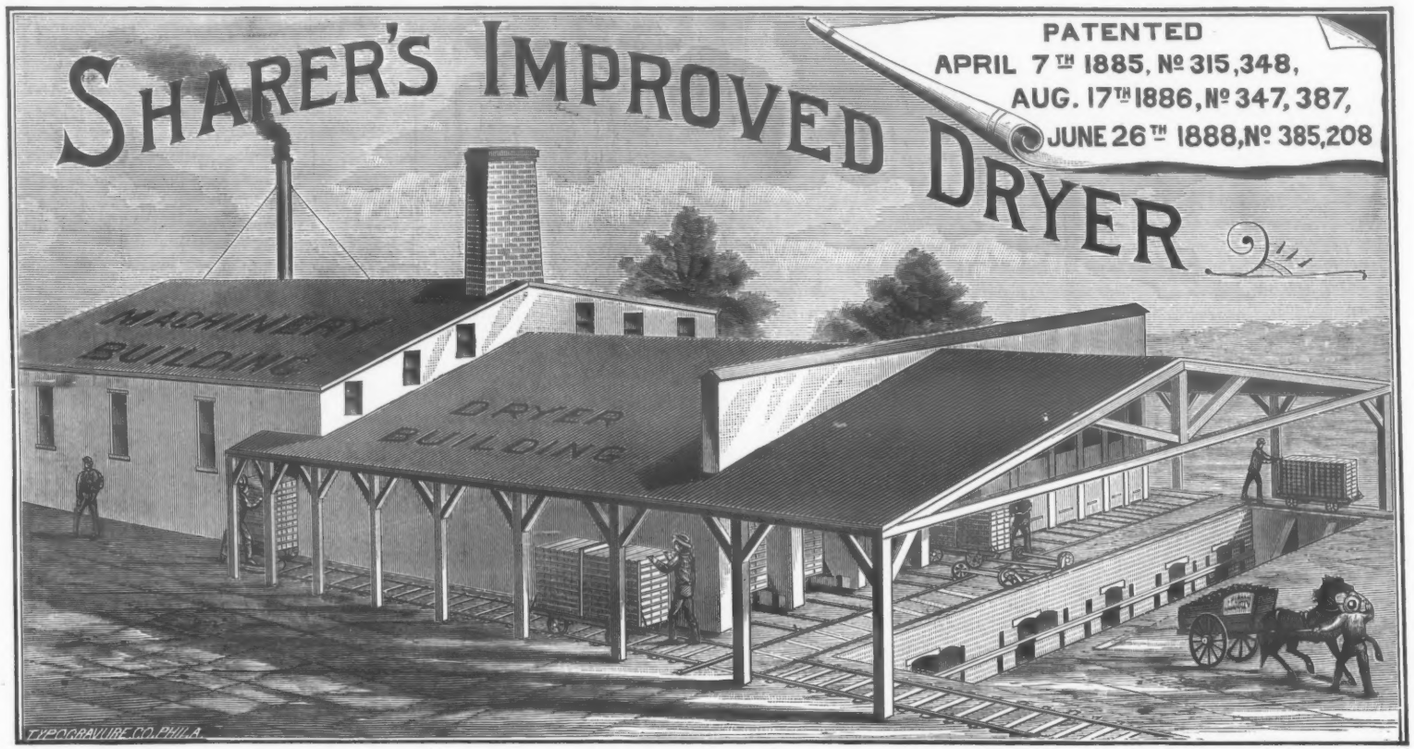
73a Queen Victoria St., LONDON.
44 Dey St., NEW YORK.
215 Franklin St., BOSTON, MASS.

Gates Iron Works, 50R S. Clinton St., Chicago.

The SHARER

IS THE BEST

IT DRIES BRICK



RAIN OR SHINE ✣ WINTER OR SUMMER ✣ EVERY DAY IN THE WEEK

EVERY WEEK IN THE MONTH ✣ EVERY MONTH IN THE YEAR

We GUARANTEE to Give Satisfaction

WE SOLICIT A CAREFUL INVESTIGATION OF THE

SHARER

WE WILL CHEERFULLY GIVE ALL INFORMATION REGARDING IT

AGENTS

J. A. RIDGWAY, Great Northern Hotel, Chicago, Ill.
GURNEY F. COLEMAN, Hotel Chittenden, Columbus, Ohio.
ED. H. CALLAWAY, Vanderbilt House, Syracuse, New York.
HUGH CAMERON, No. 71 Adelaide St. East, Toronto, Ont.
GEO. B. DRENNAN (Philadelphia Office).
NEW YORK OFFICE, Coleman House, 27th and Broadway.

GEO. W. SHARER,

Patentee and Owner,
Rooms 506 and 507, The Mutual Life Building,
N. W. Cor. Tenth and Chestnut Sts.,
Philadelphia, Pa., U. S. A.

WRITE FOR CATALOGUE

H. H. WAINWRIGHT,
PATENTEE.

The Anchor Artificial Curb

IRON BOUND AND
NON-BREAKABLE.

STATE RIGHT AND LICENSES FOR SALE.

PATENTED MAY 20, 1890.

ESPECIALLY ADAPTED FOR STREETS, WHARVES, RAILROAD DEPOTS, PIERS, ROADWAYS OF BRIDGES, MARKET HOUSES, BREWERIES, WAREHOUSES, ETC., ETC.

THE INVENTOR of the Anchor Iron Bound Curb has been for several years engaged in the business of laying Artificial Stone Pavements, and has put down large quantities of Cement Curbing, as at present used. THIS HAS ONE SERIOUS DEFECT, viz.: The liability to break or chip off at the outside edge or corner, from the impact of wheels of vehicles of all kinds trucks, coal carts, milk or express wagons; even wheelbarrows or bakers' carts will chip off pieces when rudely pushed against this edge, and destroy its symmetry.

The effort to overcome this objection has resulted in the present patented improvement, which is designated

THE ANCHOR ARTIFICIAL CURB.

ITS ADVANTAGES ARE

Greatly reduced cost as compared with Granite Curbing, which it will, in time, entirely supplant, as it is superior in appearance and finish.

It is provided on the outside edge with an iron plate, which strengthens as well as protects it from wear, and breaking from contact with cart or wagon wheels, or other causes of injury. This plate, being galvanized, does not discolor the face of the curb.

In addition to this, two bars of angle iron form the front and back of the bottom of the curb, making it **Iron Bound** on THREE corners, and tie rods are imbedded in the concrete for its entire length, giving it strength equal to granite, and making it absolutely **non-breakable.**

This curb is continuous throughout its entire length, and has no joints to separate and get out of position, as the short lengths now used of the ordinary stone invariably do, after a few years of use.

Although lighter, and containing less material than the heavy stones now used, it has a strong iron frame, resting on foundation pieces, which are buried deeper than the curbstones now in use, and provided with **Anchor Plates,** which make it immovable under any circumstances.

While it is an ornamental improvement to private dwellings, it is of great value in such places as the yards of breweries, and the vicinity of market-houses, warehouses, etc., where heavy wagons are continually backing up to receive or discharge their loads.

For railroad depots, wharves, piers and shipping docks, also driveways for bridges, it will prove of great benefit, and will outlast any other kind of Curbing that could be used.

The COMMERCIAL VALUE of the Anchor Iron-Bound Curb is in the fact that it can be laid at a much lower cost than Granite curbing and pay a profit of about 50 per cent.

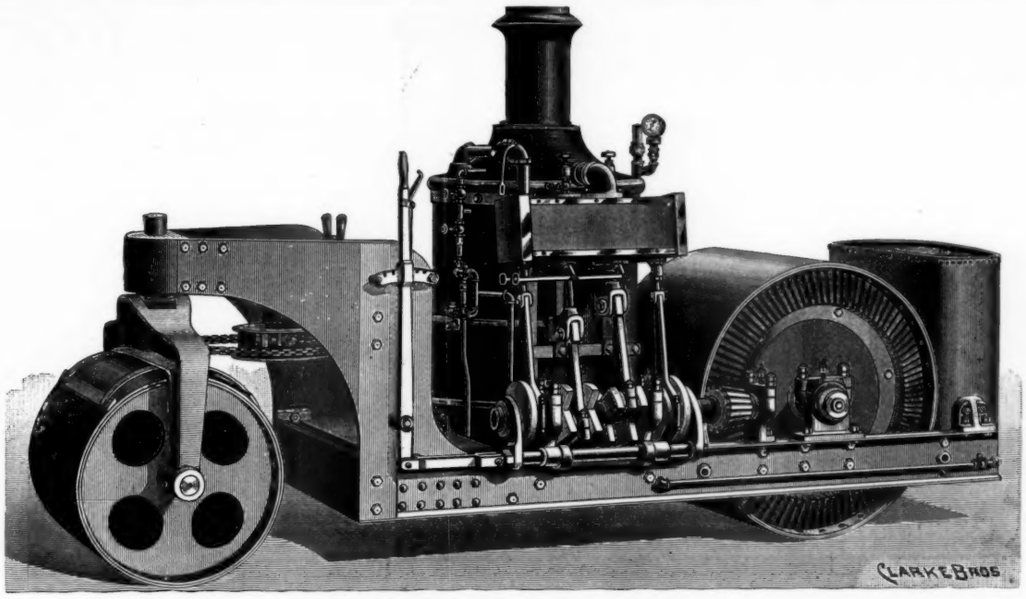
It is superior in finish and appearance to Granite or Blue-stone, and fully its equal in strength. It has been laid for some months in Washington, and subjected almost daily to severe tests, and fully justifies all representations made regarding it.

The company adopting it in Washington is one of the oldest and best known in the United States, and companies in Baltimore and Philadelphia and other places are now being formed to adopt it in connection with other branches of the Paving business.

STATE RIGHT AND LICENSES FOR SALE.

Address, for other information, H. H. WAINWRIGHT, Contractor.

Room 10, Washington Loan and Trust Company Building, Washington, D. C.



SPRINGFIELD ASPHALT ROLLER.

Made by THE O. S. KELLY COMPANY,

Springfield, Ohio.

DESCRIPTION OF SPRINGFIELD FIVE TON ASPHALT ROLLER

This small roller is designed for use on plastic pavements, gravel walks, race tracks or any prepared surfaces which require a smooth face. It is evident that these prepared surfaces may be composed of widely different materials and so would call for different degrees of compression to attain the required smoothness on the different materials used.

As smoothness, not hardness, is the important end of these prepared surfaces, it will be seen that the machine must act as a smoother rather than a roller. The difference between them being, the smoother works on soft plastic material, which becomes hard by chemical action; the roller works on hard material and compresses it to solidification by mechanical action. The smoother, however, will give sufficient hardness to race tracks, gravel walks or any non-plastic surfaces which are designed only for the lightest traffic.

ARRANGEMENT

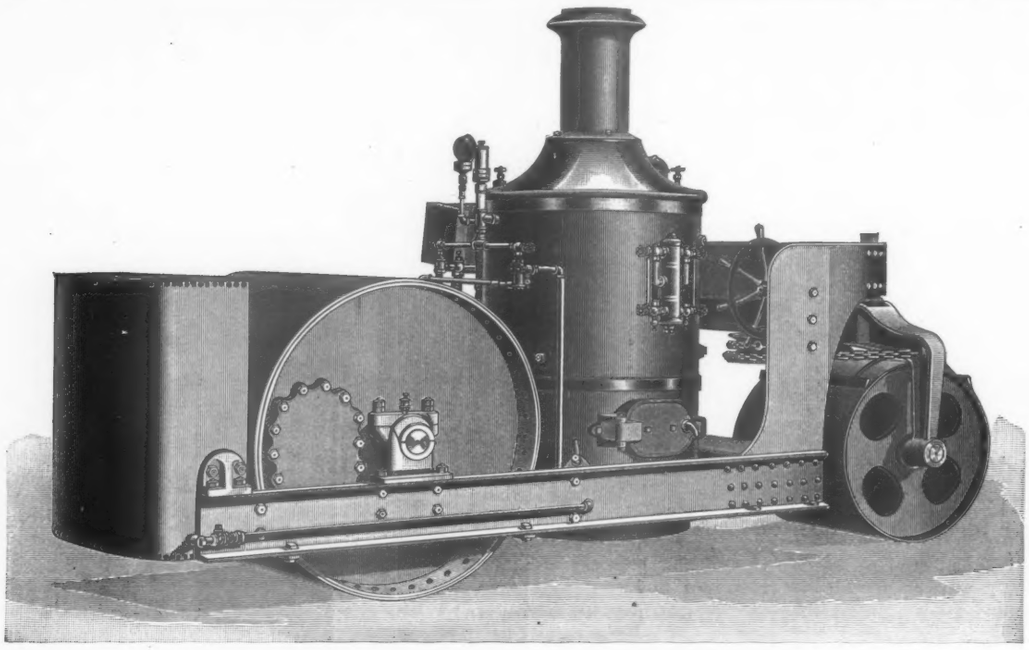
The smoother having an entirely different function to perform is constructed in a different manner to the roller. It has an outside frame constructed of channel iron, inside of which the smoothing wheels are placed so as to make a single track. This frame overhangs the track made by the smoothing wheels to the extent of four inches on each side, but as it is nine inches above the ground, the smoothing wheels can be brought up close to the curbing or any obstructions that do not exceed eight inches in height.

The smoothing wheels are called the driving and steering wheels. The driving wheel is a smooth cylinder of $\frac{3}{8}$ inch shell steel, fitted with two cast iron heads keyed to the axle which passes entirely through the hollow drum so formed. This drum is made perfectly water tight, and is large enough to carry one ton of water, or one and a half tons of sand. Two brass plugs are fitted to the head to let water in or out, and a large manhole is provided in the same head so that the drum may be filled with sand if more weight is required. A bevel gear fitted to the other head gears with the crank shaft pinion, by means of which the engine power is transmitted. The diameter of this driving wheel is forty-eight inches, the face is forty inches; and the pressure exerted by it on the prepared material, when the machine is in ordinary working condition, is 190 lbs. per square inch. This pressure can be increased to 240 lbs. per square inch by simply filling up the drum with water, or to 265 lbs. per square inch by filling the drum with sand, thus providing a range of pressure varying from 190 lbs. to 265 lbs. per square inch.

TANK

The tank, arranged to form one end of the entire machine, is placed close up to the driving wheel, and acts as a guard to the latter. It has a capacity of 80 gallons, which is sufficient to supply the boiler for four hours' work. It is built of $\frac{1}{16}$ inch tank steel fitted with two heads, containing manhole and plugs to facilitate filling and cleaning.

The boiler is of the vertical type, thirty-three inches in diameter and four feet high. The shell is of $\frac{3}{8}$ inch shell steel, having a tensile strength of 60,000 lbs., and is double riveted. The fire-box is of $\frac{3}{8}$ inch flange steel and each tube sheet is of $\frac{7}{16}$ inch flange steel. Hand-holes and plugs are freely provided for washing-out purposes. The boiler is fed by two injectors and is jacketed with wood and Russia iron. A cast iron hood surmounts the top of the boiler, giving a neat finish.



VIEW OF OPPOSITE SIDE.

ENGINE

The engine is of the double cylinder type, with cranks set at right angles (being rendered necessary through abseuce of space to contain a fly wheel). The whole engine is mounted on a strong bed plate, the crank shaft end of which is securely bolted to the frame, the cylinder end is secured to the upper end of the boiler, the whole engine is thus placed nearly vertical, and the bed plate acting as a very rigid brace between the boiler and the frame, stiffens the whole machine in a thorough manner, preventing that springing of the frame which must occur in machines not so braced.

CRANK SHAFT

The crank shaft is of steel with both cranks properly counter-balanced, which prevents the jerking motion peculiar to an unbalanced, double cranked engine. The crank shaft pinion is keyed to one end of this shaft and is always engaged with the bevel gear on the driving wheel.

REVERSING GEAR

The reversing gear is constructed on Dodd's wedge-motion principle, necessitating the use of only one eccentric and rod to reverse each engine. It is placed on the crank shaft and forms a neat compact gear embodying all the good qualities of the link motion with only one-half of the moving parts. The eccentric rods and connecting rods are made of Muntz's metal, which has the strength and toughness of wrought iron.

The steering end of this machine is formed by two steel plates, which are shaped so as to project upward and forward of the frame. The bottom ends of these plates are securely riveted to the frame. The upper ends, which are tied together by a strong cross beam, project forward and inward to a common center formed by the saddle casting containing the steel king-post. These projecting ends are securely bolted to the saddle casting, the whole forming a light structure, meeting the requirements of this end of the machine.

STEERING WHEELS

The steering wheels are two in number, but placed together on the same axle so as to form a continuous smooth drum, having the same width of face as the driving wheel, forty inches; the two sections, however, revolve independently of each other. There are thirty-two inches in diameter and twenty inches wide. The rim of each section consists of $\frac{5}{16}$ inch shell steel. The heads are of cast iron with their centers bushed with brass bushings which can be replaced when worn out. These wheels are contained within a fork of cast iron, which is especially adapted to meet all steering requirements and exigencies caused by inequalities of the surfaces.

The foot plate is situated between the boiler and the steering wheels, and is bounded on the sides by the steel plates mentioned above. All levers are operated from this foot plate which is spacious and convenient. Under this plate is kept the coal, two hundred pounds of which can be carried. This is sufficient to operate the machine for four hours. Scrapers are fitted to all wheels and a sprinkler is fitted to the driving wheel. The extreme height of the machine is seven feet three inches, the extreme length, fourteen feet, and extreme width, four feet and six inches.

SUMMARY OF DIMENSIONS, ETC.

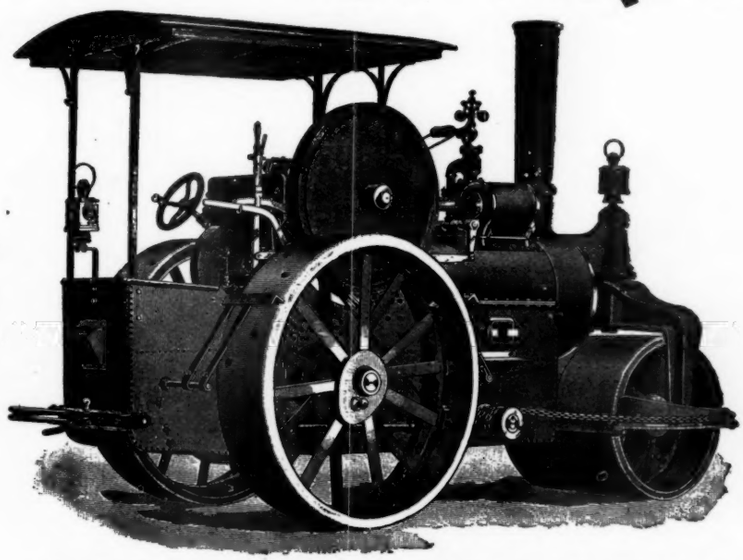
Tank capacity, 80 gallons (lasts four hours).
Coal capacity, 200 pounds (lasts four hours).
Steel Crank Shaft, double throw and balanced perfectly.
Reversing Gear capable of being used expansively.
Gearing of Steel throughout.
Driving Wheel, 48 inches in diameter and 40 inch face.
Steering Wheels, 32 inches in diameter and 40 inch face.

Finished weight	9,600 pounds.
Ordinary working weight	11,000 pounds.
Working weight with water in drum	13,000 pounds.
Working Weight with sand in drum	14,000 pounds.
Pressure exerted ordinary working weight,	190 pounds per square inch.
Pressure when drum is filled with water,	240 pounds per square inch.
Pressure when drum is filled with sand,	265 pounds per square inch.

For Cuts and Description of the Heavy Type of Road Rollers made by O. S. Kelly Co., see page

THE SPRINGFIELD STEAM ROAD ROLLER

Visitors to Chicago can see five (5) Springfield Road Rollers



At work on the World's Fair Grounds

SATISFACTION GUARANTEED

SPECIAL POINTS OF ADVANTAGE:

Among the special points of advantage peculiar to this roller and not found on other rollers are:

CAB—Protecting operator from weather.

GOVERNOR—Facilitating the handling of the machine and enabling machinery of any description to be driven.

TOOL BOXES—To carry the spikes, which take up a large space. In other machines they are generally carried in the coal bunker, which is a great nuisance, or are hauled by wagons, which is costly.

LARGE SMOKE BOX—Which does not overheat as small ones will when roller is working hard.

DOUBLE SPEED GEARING—On all sizes, permitting the operator to take all advantages.

SUPERIOR FRONT CARRIAGE—Risk of breakage reduced to a minimum.

EXTENSION DRAW BAR—Convenient for plowing.

LARGE BOILER CAPACITY—Insuring abundance of steam for any and every emergency.

LARGE DIAMETER WHEELS—Front and rear, allowing the machine to roll over very rough ground.

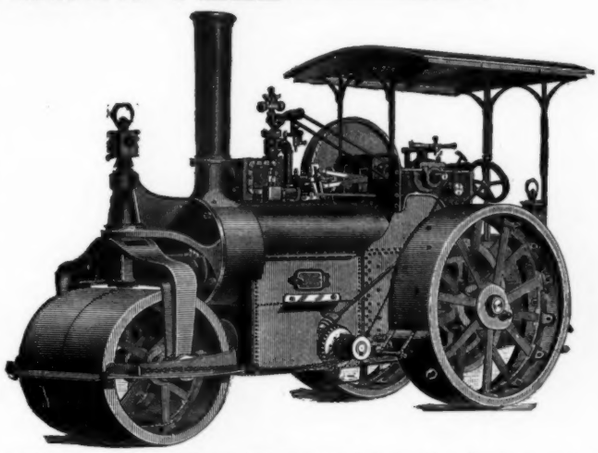
WIDE FACE FLY WHEEL—To drive a belt.

COUNTERBALANCED CRANKSHAFT—Making engine run smoothly.

HEADLIGHT LAMPS—For use at night, meeting the city laws.

LARGE WATER TANKS—Making the machine more efficient in every way.

ABILITY TO ROLL CLOSE TO CURBING, ETC.—Thereby completely finishing the whole road.



FIRE BOX VERY DEEP—To avoid frequent firing and reducing smoke

DEEP ASHPAN—Fitted with doors on each side for Cleaning.

• • • •

Handsome Illustrated Catalogue Sent Free on Application.

Address the O. S. KELLY COMPANY, SPRINGFIELD, OHIO.

For Cuts and Description of Asphalt Rollers made by this company see pages —— and ——.

HARRISBURG Foundry and Machine WORKS

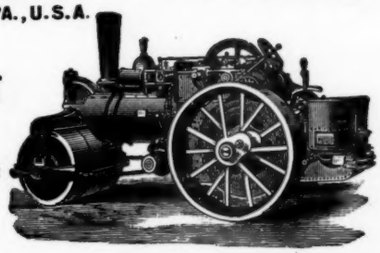
General Office and Works: HARRISBURG, PA., U.S.A.

THE HARRISBURG Double-Engine Road-Roller

Not only a Roller, but a Road-Machine.

NOT HOW CHEAP, BUT HOW GOOD.

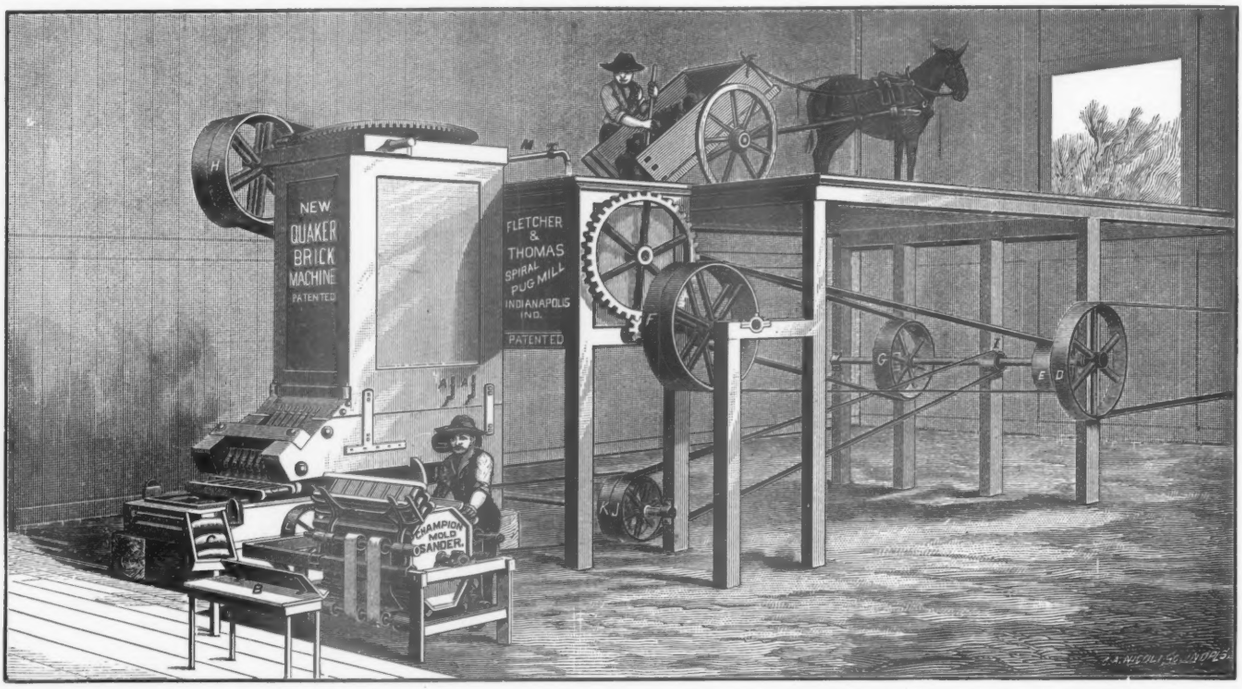
NOW IN USE IN NEARLY ONE HUNDRED CITIES AND TOWNS IN THE UNITED STATES.



W. R. FLEMING & CO.,
Mail and Ex. Build'g, N. Y.

FRANK JOHNSTON,
24 S. 7th St. (Build. Ex.), Phila.

FLETCHER & THOMAS



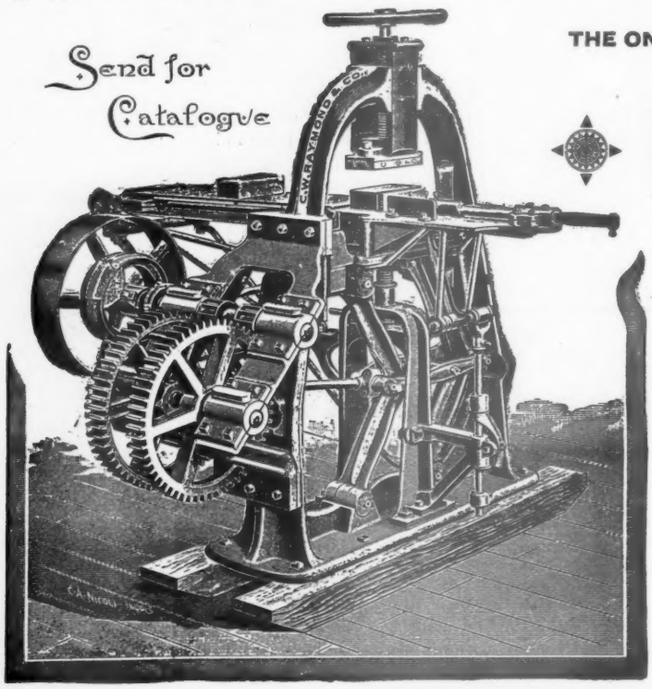
Improved Brick-Making Machinery

The above cut represents the New Quaker Complete Combined Steam Power Outfit. Capacity, 40,000 per day. Capacity of Horse-Power, 15,000 to 20,000. The most perfect machinery for making PAVING BRICKS, FIRE BRICKS or COMMON BRICKS. We make a specialty of equipping yards complete in every detail ready for work. Send for illustrated catalogue.

Correspondence Solicited. **FLETCHER & THOMAS, INDIANAPOLIS, INDIANA.**

RAYMOND'S AUTOMATIC POWER PRESS

Send for Catalogue



THE ONLY SUCCESSFUL RE-PRESS FOR MAKING

PAVING BLOCKS

RED AND FIRE BRICK, ROOFING TILE, ETC.

A rapid working and powerful machine for pressing paving blocks, by which they are given great density and uniformity of size and finish. Make from 8 to 12 thousand finished paving blocks per day. No first-class paving brick made without re-pressing.

Dumping Cars, Portable Track,
Dryer Cars, Transfer Cars
and General Brick Yard Supplies.

C. W. Raymond & Co., Dayton, Ohio.

INDIANA BRIDGE COMPANY

Wrought Iron High Truss Bridge, one Span, 210 feet, over Mississinewa River, at Sharon, Delaware County, Indiana.

MANUFACTURERS OF

Wrought Iron Bridges
Iron Sub-Structures,
Viaducts, Roofs & Buildings

Muncie, Indiana.

DIRECTORS.
C. M. KIMBROUGH, President and Gen. Mgr.
JOHN R. MARSH, Secretary and Treasurer.
A. L. JOHNSON. GEO. F. MCCULLOCH. T. F. ROSE.

WE BUILD ANY KIND OF IRON BRIDGES WANTED.

Can give satisfactory reference to larger amount and greater variety of work done in Indiana than any other Bridge Company. We are the only Company operating shops in the state. We invite inspection of our shops for efficiency and capacity.

NOTICE OF LETTINGS SOLICITED.

OVER 200 OF OUR PATENT LEG BRIDGES IN USE
IN THIS STATE.

The Best Bridge for Spans up to 70 feet. We sell only our own Manufacture. Address all communications to

Indiana Bridge Co., Muncie, Ind.

Above cut shows our Patent Leg Bridge.

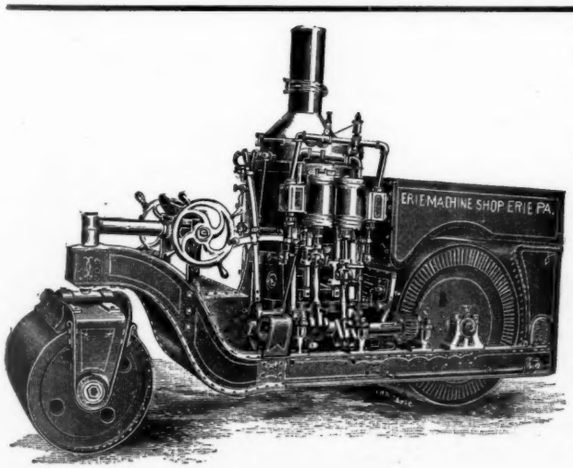
GALESBURG PAVING BRICK.

The demand for these Celebrated Brick has hitherto far exceeded the supply. By the erection of one of the largest and most complete plants in the country, the PURINGTON PAVING BRICK COMPANY expects to be able to furnish these Brick in any desired quantity, and to fill all orders promptly and satisfactorily. ∴ ∴ ∴ ∴ ∴ ∴ ∴

Prices and samples furnished on application to

PURINGTON PAVING BRICK COMPANY,

First National Bank Building, Galesburg, Ill.



ERIE MACHINE SHOP,

MANUFACTURERS OF

Steam Rollers

Corner Twelfth and State Streets,

ERIE, PA.

The principal Asphalt Paving Companies in the country are using these machines, which are pronounced to be the best in the market.

WHY DOES

THE U. S. DRY CLAY BRICK PRESS

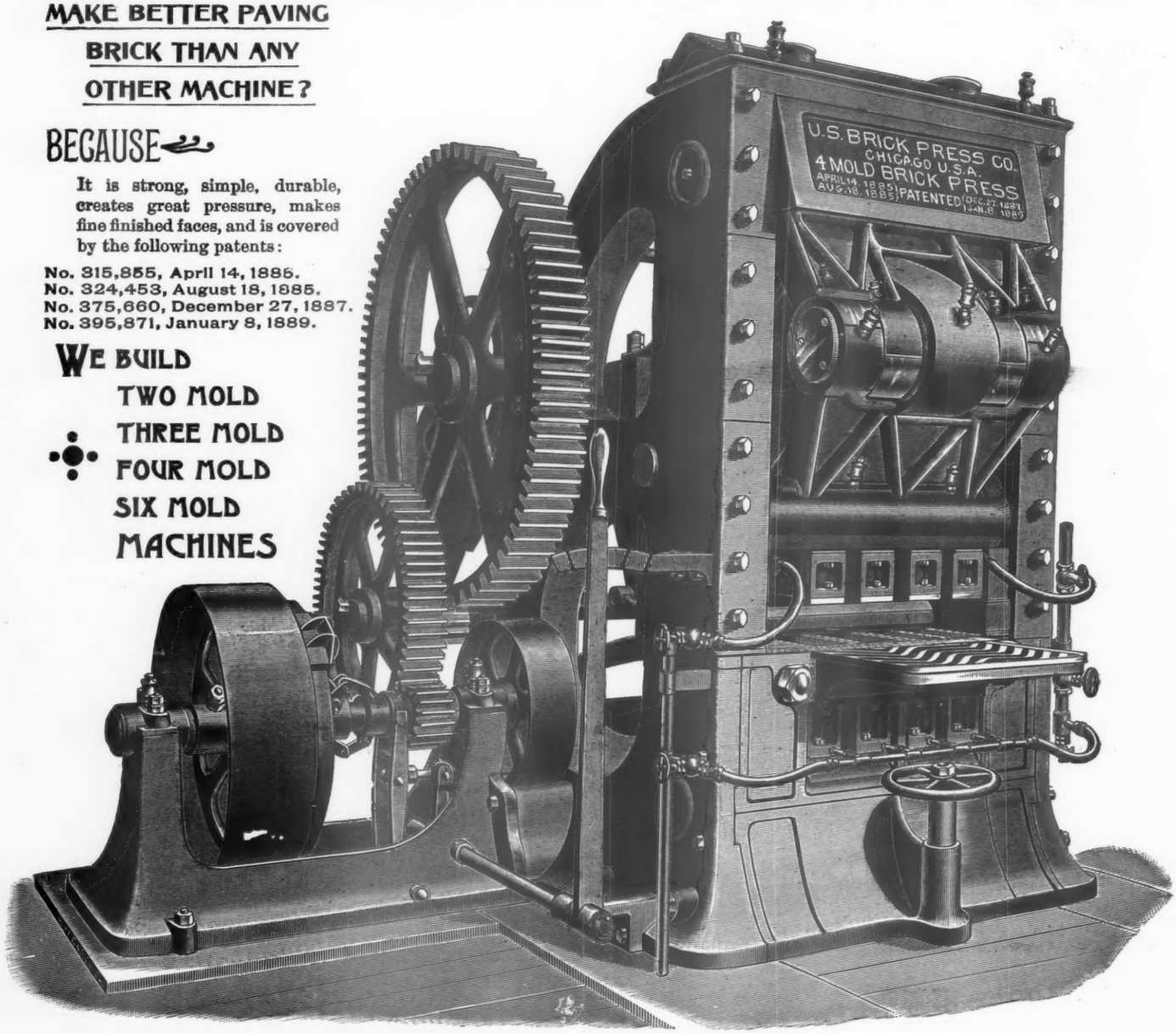
MAKE BETTER PAVING BRICK THAN ANY OTHER MACHINE?

BECAUSE

It is strong, simple, durable, creates great pressure, makes fine finished faces, and is covered by the following patents:

No. 315,855, April 14, 1885.
No. 324,453, August 18, 1885.
No. 375,660, December 27, 1887.
No. 395,871, January 8, 1889.

WE BUILD
TWO MOLD
THREE MOLD
FOUR MOLD
SIX MOLD
MACHINES



Clay sent us, freight prepaid, will receive our prompt attention, pressed and burned, and sample brick returned.

SEND FOR CATALOGUE AND PRICES TO

THE UNITED STATES BRICK PRESS COMPANY,

OSWALD KUTSCHE, PROPRIETOR.

1111 UNITY BUILDING—79 DEARBORN STREET,

CHICAGO, ILL.

Mention Paving and Municipal Engineering.

CALIFORNIA ASPHALT

MINED AND REFINED BY THE STANDARD ASPHALT CO.
BAKERSFIELD, CALIFORNIA.

For Streets, Sidewalks and Courts,
Reservoirs, Flumes and Ditches,
Floors of Warehouses, Cellars, Stables,
Breweries, Car Sheds,
Engine Rooms and Foundations.
Coating of Piles, Bridge, Dock and Tunnel Timbers.
Interstitial Filling of Stone, Wood and Brick Pavements.
Send for Circular and Samples.

Cycling Honesty

There are a good many bicycles of beauty, lightness, wear—The modern bicycle is well built, whether it be a Columbia or some other—perhaps the facts that there are more active Columbias than all other high-grade bicycles in America; that the Columbia factory, by heavy majority, is the largest and most complete in the world, a factory which does not know how to produce a low grade machine; the unanimous opinions of skilled experts;—altogether, may suggest that it is safer to buy a Columbia. Book about Columbias free on application to any Columbia agent, or sent by mail for 2 two-cent stamps. Pope Mfg. Co., 221 Columbus Ave., Boston.

THE WESTERN
Paving and Supply Company

CONTRACTORS FOR
TRINIDAD ASPHALT PAVEMENTS,
THE STANDARD PAVEMENT OF AMERICA.

Over five million square yards in use in the United States.

It has, in fifteen years, raised the streets of Washington and Buffalo from the poorest to the best in the United States.

It will raise the streets of any city that uses it to the same high grade.

It is the only pavement that will do it.

It is the only perfect sanitary pavement.

It enhances the value of abutting property as much as it improves the city using it.

It is the ideal pavement of modern times.

We invite an inspection of our work.

GENERAL OFFICES, 36 LaSalle Street, CHICAGO.
INDIANAPOLIS OFFICE, 33 Ingalls' Block.
DETROIT OFFICE, Cor. Jefferson Avenue and Griswold Street.

FOR
CUBAN ASPHALT

ADDRESS
OTTO D. DROOP.
MINE OWNER,
Havana, Cuba.

California Asphalt

The Oil Burning and Supply Company furnish the finest and purest grades of Refined California Asphalts for Paving, Roofing, Paints, Varnishes, Electrical Works, etc. Our Liquid Asphalt for Fluxing and Tempering is the finest article in the market. We recommend our **A G** Brand for Paving, 85 per cent. to 90 per cent. pure. Contractors and Dealers supplied in quantities to suit on short notice. Samples on application. Address

The Oil Burning and Supply Company,
8 and 9 BURDICK BLOCK, LOS ANGELES, CAL.

LAKE ASPHALT LAKE ASPHALT

THE BARBER ASPHALT PAVING CO.

THE TRINIDAD BARBER ASPHALT PAVING CO. GENUINE ASPHALT TRADE MARK

USES LAKE ASPHALT ONLY.

THE OLDEST AND LARGEST Asphalt Paving Company in the United States; has laid Asphalt pavements in thirty-three cities of the Union, on 857 streets of a length of 442 miles, or an area of 5,915,000 square yards. It has laid more pavement in fourteen years than all other Asphalt Paving Co's in Europe and America Combined have laid in thirty years.

GENERAL OFFICES, NO. 1 BROADWAY, NEW YORK.
LE DROIT BUILDING, WASHINGTON, D. C.

TRADE BERMUDEZ PURE PURE ASPHALT. MARK.

THE NEW YORK AND BERMUDEZ CO.

having acquired by purchase the largest lake or deposit of Asphalt in the world, covering an area of over 1,000 acres, situated in State of Bermudez, Venezuela, and having expended large sums of money in perfecting shipping facilities, are now prepared to sell and deliver a refined Asphalt of over 95 per cent. purity and of a quality far superior to any other for paving, roofing, etc. It will do 50 per cent. more work than any other Asphalt. We guarantee its excellence and purity, and Prof. E. J. De Smedt, our chemist, will give scientific and expert instructions to parties using it.

NEW YORK AND BERMUDEZ CO.

25 BEAVER STREET, NEW YORK.

WE MANUFACTURE

Brick and Tile Yard Supplies OF ALL KINDS

If needing anything in this line, please correspond. Illustrated Catalogue Free.

D. J. C. ARNOLD, New London, O.

FUEL GAS

Adapted to every kind of kiln, from the AMATEUR CHINA DECORATORS' KILN to the mammoth BRICK KILN, and to every kind of METALLURGICAL FURNACE. Unlimited TEMPERATURE with minimum of FUEL.

Send stamps for pamphlet. PRODUCER *versus* NATURAL GAS.

W. WAPLINGTON, 5420 Vine St., Philadelphia, Pa.

THE SOUTHERN GRANITE CO.,

GEORGE MOERLEIN, President.
JOHN GOETZ, JR., Vice-Pres't.
J. A. EBERHARDT, Sec'y, Treas. & Gen. Mgr.

General Contractors in **GRANITE.**

QUARRIES AT LITHONIA, REDAN AND ROCKDALE, GA.

Street Paving Work a Specialty.

20 KIMBALL HOUSE BLOCK, ATLANTA, GA.

OFFICES

19 & 20 WIGGINS' BLOCK, CINCINNATI, O.

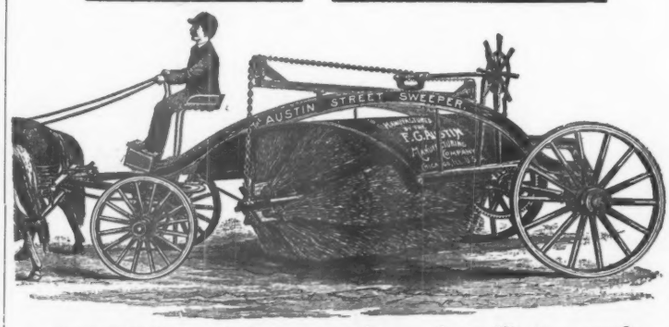
THE BEST PAVING MATERIAL

While Paris, London and Berlin are putting down miles of wood pavement yearly, having proven it the best and most economical, though costing much more there than here, some cities in our own country profiting by their experience are doing the same, as ten miles of our *sapless cylindrical paving blocks* will be laid in Michigan and Indiana during the season of 1891, making an ideal roadway at a low cost. Our second quality blocks make the cheapest crosswalks and warehouse floors and paving for private alleys. Cities desiring the best paving material—dollar for dollar—in the world, should not fail to investigate the merits of our product.

ROSS SAPLESS BLOCK PAVING COMPANY,

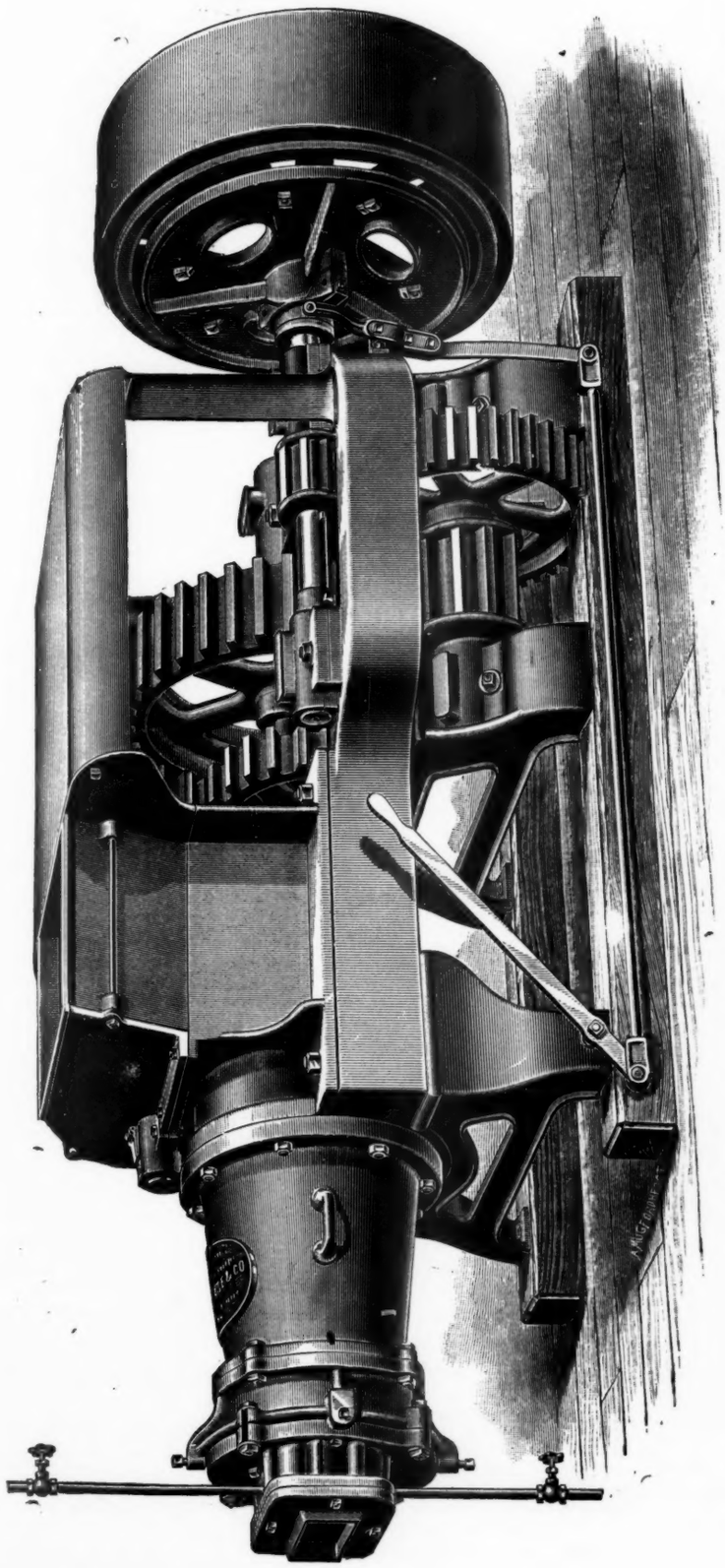
SAGINAW, E. S., MICHIGAN.

STREET SWEEPER



Streets 28 feet wide between curbs are cleaned in two rounds.
Operated by driver and two horses. For particulars, address
F. C. AUSTIN MANUFACTURING CO CHICAGO. ILL.

The New "Ohio" Brick Machine.



THE MACHINE IS WELL MADE.

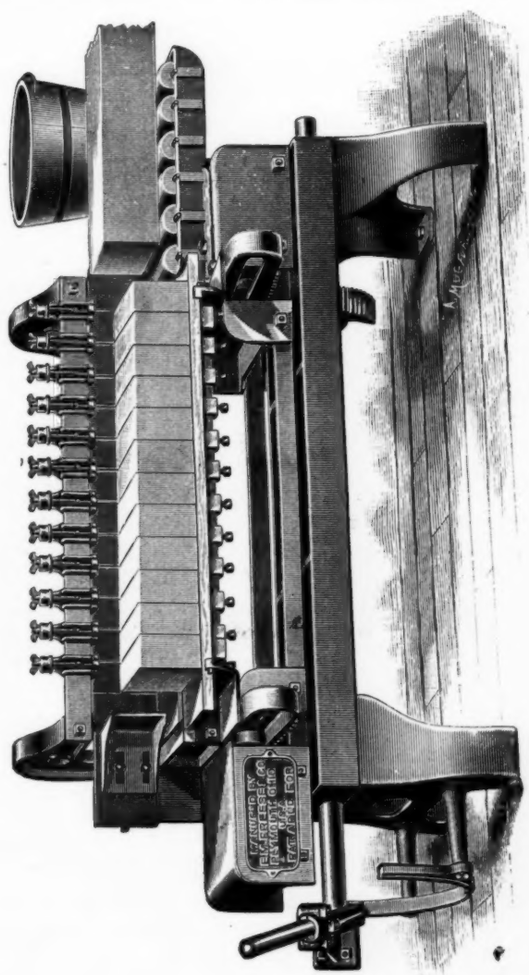
AND IS SUBSTANTIAL AND SERVICEABLE.

IT HAS special advantages not found in others, and will produce brick of the best quality at the lowest cost.

PARTICULARLY WELL ADAPTED TO THE MANUFACTURE OF STREET PAVING BRICK OF THE GREATEST DENSITY.

FOR FURTHER PARTICULARS, ADDRESS

E. M. FREESE & CO., GALION, OHIO.



J.W. PENFIELD & SON

About ....

Automatic Cutters.

Nobody wants a poor automatic cutter.

A poor brick machine is bad enough, but a poor automatic cutter will spoil the work of the best brick machine made, and is worse than none at all.

But, when the brick machine is first-class and the automatic cutter perfect, everything moves along smoothly and regularly, and you are well on the road to success in the profitable manufacture of brick.

WILLOUGHBY, O. U.S.A.

J.W. PENFIELD & SON

A Good Reason—

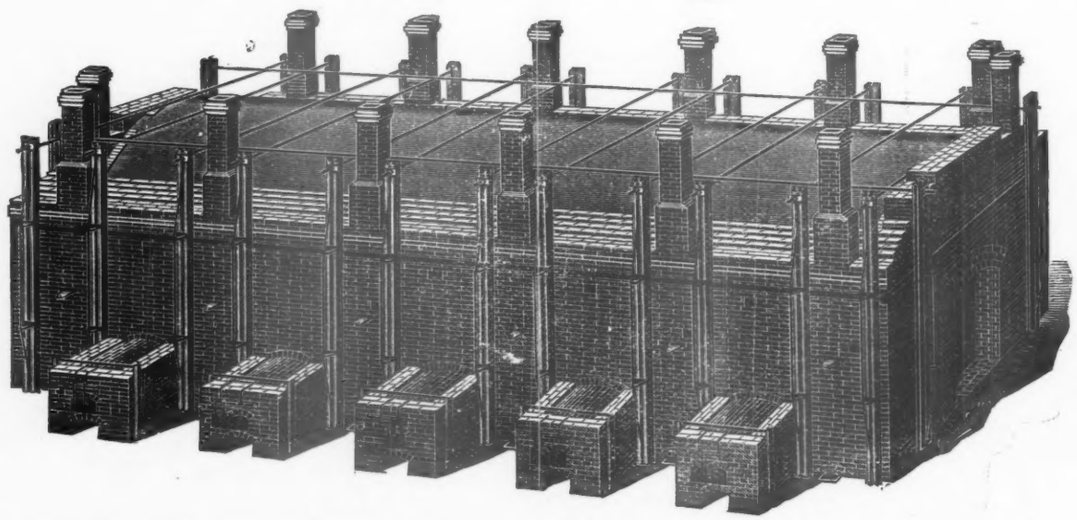
But not the only one—why you should use Penfield Modern Auger Brick Machinery, is because their automatic cutter completely meets the requirements of brick-makers of experience, and supplements the effective work of their brick machines in a most satisfactory manner.

Send for particulars and free book on "Brick Pavements."

J. W. PENFIELD & SON,
Willoughby, Ohio.

WILLOUGHBY, O. U.S.A.

The Eudaly Kiln



Is No Longer an Experiment. Burns All Hard

This kiln is used by a majority of the largest STREET PAVING BRICK PLANTS in the country. It has no superior for FINE PRESSED OR FRONT BRICK. For further particulars

Address W. A. EUDALY, 64 Johnston's Buildings, Cincinnati, O.